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Bulletin

Fresno State College

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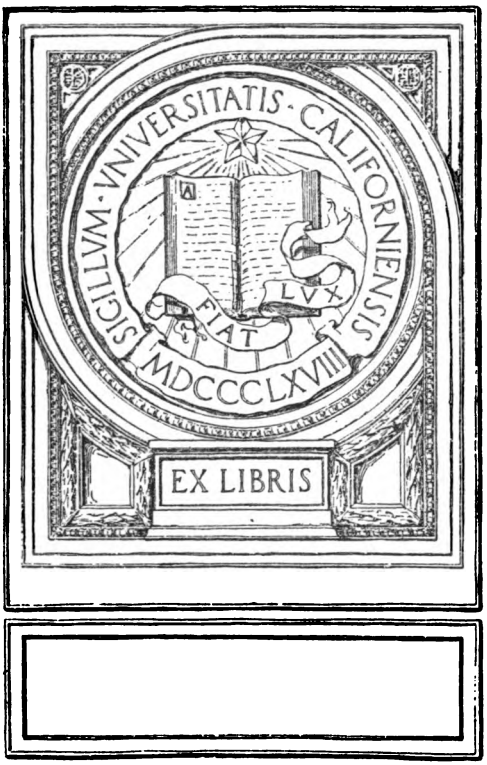

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BULLETIN No. 2

FRESNO STATE NORMAL SCHOOL

Studies in Elementary Agriculture

FRESNO, CALIFORNIA

MARCH, 1915

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1915

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Cunningham, State Normal-
school, Fresno,
Bulletin -

Studies in Elementary Agriculture

BY

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INTRODUCTION.

The subject of Agriculture has won a permanent place in the common school curriculum. It is now classed along with music, drawing and manual training as one of the special subjects. In a few more years agriculture and domestic science will form the foundation upon which the new curriculum of the common school will be built. "But what of the cultural subjects?" I hear the multitude ask. Those of the old order must yield to those of the new; to that culture that teaches human minds to conceive and human hands to put in order a beautiful home, whether it be a cottage or a large modern dwelling; to that culture that gives woman complete knowledge of the child mind and the child body to aid mother love in rearing cultured men and women; to that culture that teaches men to lay out and to build beautiful roads and to develop beautiful villages and school grounds; to that culture that teaches men and women to love God's great out-of-doors better than the man-made cities. When the subjects of agriculture and domestic science come in their fullness they will bring real culture.

The studies of the following pages constitute part of the laboratory course given with the subject of agriculture in the Fresno State Normal. They are designed to prepare teachers for presenting the subject of agriculture in the rural school. They are not predigested and ready for presentation to the child with teacher's story, introduction, description and conclusion complete, but are outlines to direct the student in preparing the studies for presentation to the child. The work of the student is complete only when, through his own efforts, each study is ready, from the teacher's story to the conclusion, for presentation to school children. Through the preparation of these studies the student gets a broad knowledge of elementary agriculture, experience in preparing subject matter and material for presenting agricultural studies and nature study lessons, and begins to find, understand, and appreciate the beauty of all things out of doors.

Acknowledgment. The author claims but little originality for the following studies. Only a few of them are his own. Every available source has been drawn upon for these studies—Government Bulletins, Textbooks, Agricultural College, Experiment Station and Normal School Bulletins. Something like a hundred and sixty studies have been given a three years' test in the laboratory, and the following chosen as being worth while. Mr. C. L. Flint, Instructor in Agriculture, Fresno State Normal, and A. E. Balch, Deputy County Superintendent of Public Schools of Fresno County, have given many valuable suggestions for the studies. The following publications have furnished many suggestions for the final preparation of this series: *Elements of Agriculture,* by

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G. F. Warren; *Agriculture Through the Laboratory and School Garden,* by C. R. Jackson and Mrs. L. S. Daugherty; *First Course in Biology,* by L. H. Bailey and Walter M. Coleman; *Publication No. 34 of the University of California Syllabus Series of the Department of Agricultural Education,* by C. A. Stebbins; *Circular No. 58 of the University of California College of Agriculture, "Experiments with Plants and Soils in Laboratory, Garden and Field,"* by Frank E. Edwards; *Farmers Bulletin No. 408 of the U. S. Department of Agriculture, "School Exercises in Plant Production,"* by Dick J. Crosby and *Laboratory Manual in Biology,* by Richard W. Sharpe.

SOLON W. CUNNINGHAM.

SPECIAL APPARATUS.

Every rural school should be equipped with some little apparatus that will aid in presenting the subjects of agriculture and nature study. The following suggested list is not very expensive and would make it possible for the teacher to present interestingly many practical things in the study of insects, plants and soils. (Fig. No. 1.)

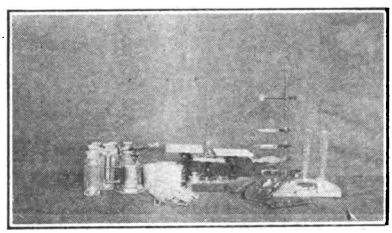

Fig. No. 1. Inexpensive apparatus every rural school should possess.

The prices given are those quoted by the Braun-Knecht-Heimann Co., 575-584 Mission street, San Francisco, at the time of the publication of this bulletin.

Harvard trip scale	$6 65
Weights (500 gram piece to 1 gram)	2 50
Gasoline burner (adjustable laboratory form)	5 00
Ring support, base 4" x 6", rings 3", 4" to 5" in diameter	1 00
2 Dissecting scopes	5 00
2 Graduate glasses, 250. c.c.	2 20
1 Set dissecting tools	1 50
2 Doz. test tubes	60
2 Test tube clamps	80
1 Doz. eight ounce bottles, plain flint glass	45
½ Doz. pipestem triangles (medium)	40
2 Test tube clamps, Stoddard's	30
2 Thermometers	1 10
1 Doz. porcelain crucibles, Royal Meissen	1 20
Total	$28 70

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FOREWORD TO THE TEACHER.

You are interested in the study of agriculture and wish to make the subject more interesting to the children. The following studies open a way for you to do so. They mean a little extra work and additional reference reading on your part but the results obtained will compensate many times for the extra work. This bulletin is a guide for the teacher and should not be given to grade school children as a laboratory manual. Neither should the studies be substituted for either the school garden or the home garden, but should correlate with and supplement the garden work and the study of the textbook.

The graduates of the Fresno State Normal School are trained to use these studies. The teacher who has not studied the series should do so before outlining the work for the class. If the class be large, divide the children into groups of four to six and have the groups take turns in preparing the studies under your direction as demonstration studies for the class. The remainder of the class may observe the work, and through the writing of a short essay tell what was used and describe each step in preparation of the study.

Your school will not possess the equipment that makes possible the taking up of all of these studies. *However, take special note of the fact that the big majority of them do not require chemicals and special apparatus. The studies marked with the star can be carried out with tin cans, pie tins, water glasses and small wooden boxes (cigar boxes are excellent).* All of these can be collected by the children.

For the series of studies upon the soil, a grain sack of each of the following types of soil should be obtained, and half of each type put where it will dry and keep dry: sand, loam, clay and humous soil. (The term "humous soil" as used in this publication means a soil rich in decayed and decaying plant matter.)

Should the taking up of these studies be the first of this sort of work you have done, you will find that, through your lack of experience in handling such work, some of the studies will not give the results they should. Do not let this discourage you. Study the situation, check over your work, look for the cause of failure and work out the study again and still again if necessary. The Faculty of the Department of Agriculture of the Fresno State Normal School is ready at all times to give any aid you may ask in this work.

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ORIGINAL WORK FOR THE STUDENT TEACHER.

Prepare from each of the following studies a lesson outline for seventh and eighth grade children. The following outline will give you an idea for a general plan.

Study Number One.

I. Illustrative material.
   1. Pictures of a stream showing water-worn rocks and stream-cut banks.
   2. Rounded pebbles and rocks from a stream.
   3. If a stream be convenient, make plans to visit it.

II. Order of presentation.
   1. Perform "Study Number One."
   2. Show pictures and smoothed and rounded rocks and pebbles.
   3. Visit a stream if possible.

III. Teacher's story.
   1. Describe quite fully the work of the creek.
   2. Tell how the stream got its rocks and pebbles.
   3. Tell what the stream is doing with them.
   4. Tell what finally becomes of them.
   5. Contrast normal stream work with its work at flood time.

Books for Reference Reading.

1. Principals of Botany; Bergen and Davis.
2. Botany for Schools; Atkinson.
3. Practical Botany; Bergen and Caldwell.
4. Elements of Agriculture; Warren.
5. Principles of Agriculture; Bailey.
6. First Course in Biology; Bailey and Coleman.
7. Principles of Agriculture Through School and Home Garden; Stebbins.
8. Agriculture for Schools of the Pacific Slope; Hilgard and Osterhout.
9. Handbook of Nature Study; Comstock.
10. Nature Study; Hodge.
11. Nature Study; Cummings.
12. Soils; Hilgard.
13. Soils; King.
14. The Fertility of the Land; Roberts.
15. Applied Biology; Bigelow.
16. Cyclopedia of American Agriculture; L. H. Bailey.

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SOIL STUDIES.

*Study Number One.

Water Disintegrates Rocks.

Apparatus—Heavy glass, pint bottle, stopper for same.

Materials—Small pebbles, water.

Procedure—Wash a half dozen to a dozen of the pebbles until they are clean. Place them in the bottle, fill the bottle two-thirds full of water, cork tightly and shake vigorously for ten minutes. (Let the pupils take turns in shaking the bottle.)

Note the clear water taking on a change of appearance as the shaking proceeds. (Fig. No. 2.)

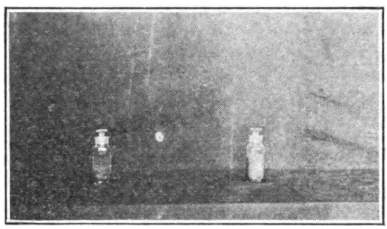


Fig. No. 2. Illustrating study number one.

Questions—1. What caused the clear water to get muddy? 2. Where is this process being carried on in nature?

NOTE.—Illustrate what the student has seen taking place here with smooth and rounded stones taken from the bed of a stream.

*Study Number Two.

Water Disintegrates and Transports Soils.

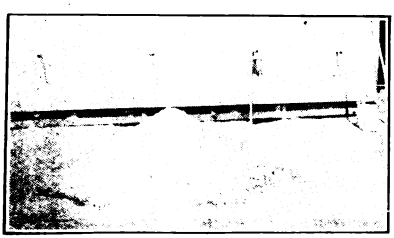
Apparatus—Spade and water sprinkler.

Materials—Soil, large pebbles, gravel and sand.

Procedure—In an out-of-the-way place throw up a cone shaped pile of soil about two feet high and six feet in diameter at the base. Mix in the soil as it is being piled, quite thoroughly, pebbles, gravel and sand. Sprinkle the mound a half dozen times as it is being built. Allow the mound to settle for a week or ten days, sprinkling it occasionally to harden and pack the surface.

With the sprinkler, sprinkle water slowly on the top of the mound. Note how little streams are cut, how this miniature hill is being worn down, how the soil is being deposited at the base of the mound.

Make comparison of the work of water done here under the pupils' observation to the work of water under natural conditions. (Figs. No. 3 and No. 4.)



Figs. Nos. 3 and 4. Illustrating study number two.

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Questions—1. How have the alluvial plains at the base of mountain ranges been formed? 2. How have our river valleys and canyons been formed? 3. Why are the beds of our streams and rivers composed chiefly of rocks, gravel and sand? 4. If the sprinkling were continued long enough what would happen to the mound? 5. Why is our best farming land found in the river valleys?

---

*Study Number Three.

The Transporting Power of Water.

Apparatus—Four ounce bottle, scales and weights.

Materials—To be obtained.

Procedure—Weigh the four ounce bottle. From an irrigation ditch or natural stream, in which the water is carrying a great deal of material in suspension, fill the bottle. Dry the outside of the bottle, and weigh it and its contents. Set it aside until the water becomes clear. Carefully pour into an evaporating dish all of the water possible without losing any of the sediment. Set the bottle aside or put into the drying oven until the sediment is dry, then take a third weighing. Put the evaporating dish over a burner and evaporate off the water. Note results. (Fig. No. 5.)

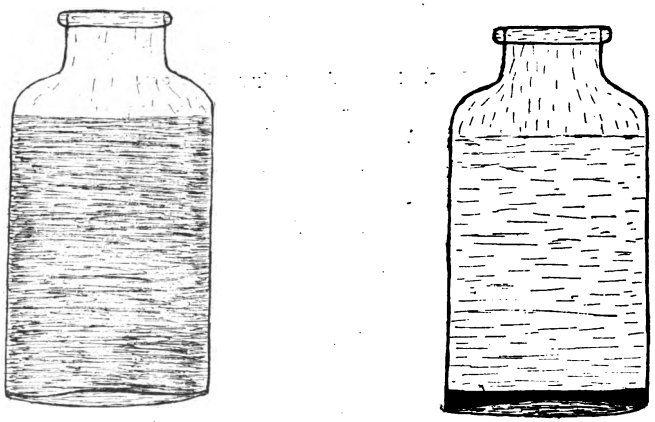

Fig. No. 5. Illustrating study number three.
1—Muddy water from irrigation ditch.
2—Sediment separated by settling.

Calculate the per cent of sediment_____
Weight of bottle _____
Weight of bottle and water_____
Weight of bottle and dry sediment_____
Weight of water _____
Weight of dry sediment _____
Per cent of sediment_____

Questions—1. After evaporation, what was left in the evaporating dish? 2. In what two ways does water carry material? 3. What material is of direct food value to the plant? 4. Does the material in suspension in irrigation water in any way benefit the land? 5. Are there any conditions under which the material in solution in irrigation water might harm the land?

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*Study Number Four.

The Assorting Power of Water.

Apparatus—Pint fruit jar, lid and rubber for same.

Materials—Sand, loam, clay and gravel and water.

Procedure—Put a tablespoonful each of sand, clay, loam and gravel into the jar. Fill the jar two-thirds full of water. Put the lid on the jar and shake vigorously, giving the water a rapid whirling motion in the jar. Set the jar aside until the water becomes clear. Note the arrangement of the earth material in the bottom of the jar. (Fig. No. 6.)

Fig. No. 6. Illustrating study number four.

Questions—1. What is the cause of the arrangement of soil in the jar? Explain. 2. Have you ever noticed this being done by running water under natural conditions? Explain. 3. What is done with the material carried by running water when a creek or river is at flood tide?

Study Number Five.

Chemical Action of Carbon Dioxide.

Apparatus—Florence flash, thistle tube, right angle tube, two-hole stopper, two water glasses, rubber tube, pneumatic trough.

Materials—Marble or limestone, lime water.

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Procedure—Set up the apparatus for the generation of carbon dioxide. (Fig. No. 7.) With the rubber tube bubble the gas through a third of a glass of lime water. Note what takes place in the lime water. Account for the change you see. Continue to bubble the gas through the lime water until you get clear water again.

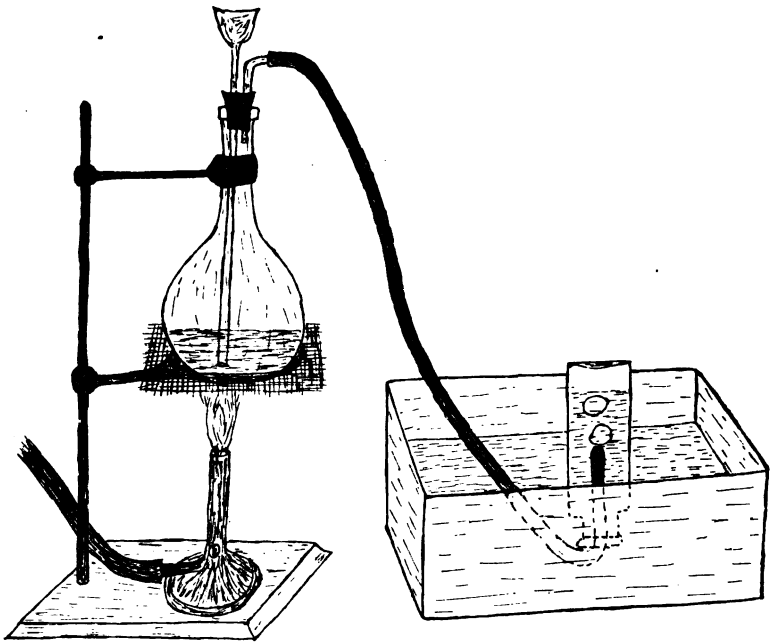

Fig. No. 7. Illustrating apparatus used in study number five.

Questions—1. What caused the changes seen above? 2. Is carbon dioxide a soil destroyer or a soil builder? Explain. 3. How is the above process carried on under natural conditions? Explain fully.

Study Number Six.

Water in Soils.

Apparatus—Scales and weights, Bunsen burner, 4 porcelain crucibles.

Materials—To be obtained.

Procedure—Collect under field conditions samples of loam, clay, sand and humous soil.* Carefully weigh each of the four crucibles. In one weigh a ten gram sample of clay, in another loam, another sand, and in the fourth humous soil. Dry in an oven at 96 degrees centigrade for 24 hours. Reweigh each crucible with sample. Compute the per cent of water in each soil.

Weight of crucible _____
Weight of crucible and soil _____
Weight of soil _____
Weight of crucible and dried soil _____
Weight of dried soil _____
Weight of water _____
Per cent of moisture _____

Questions—1. Which soil contained the most water? Explain why. 2. How is this water held in the soil? 3. In which soil would an equal per cent of water be of most benefit to the plant? Explain.

*In this publication the term "humous soil" is used to signify a soil rich in decayed and decaying plant matter.

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*Study Number Seven.

The Illustration of Capillarity.

Apparatus—Jelly glass, 4" x 4" square of cardboard, half dozen pieces glass tubing of different size bore four to six inches in length.

Materials—Water, red or blue ink.

Procedure—Put a half dozen drops of ink in a glass one-fourth full of water. Make four perforations in the cardboard and place the glass tubes through them, letting each tube stand on the bottom of the glass and the cardboard rest on the top of the glass. Note the height the colored water rises in each tube. Illustrate by drawing. (Fig. No. 8.)

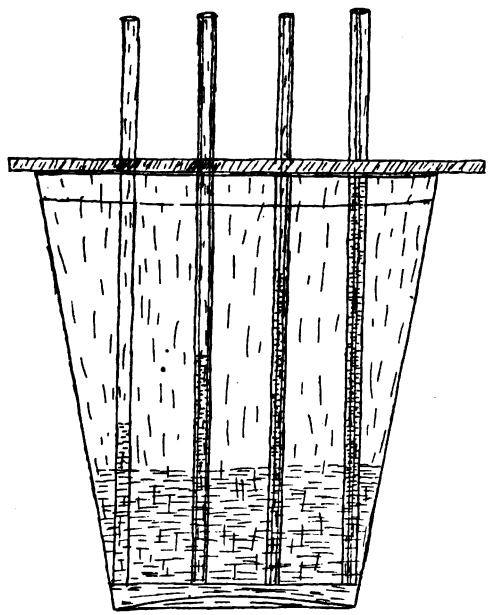

Fig No. 8. Illustrating study number seven.

Questions—1. In which tube does the water rise the highest? 2. In which does it rise the least? 3. In what sort of soils would water rise the highest by capillarity?

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*Study Number Eight.

The Capillarity of Soils.

Apparatus—Four student lamp chimneys, rack and six pie tins, foot rule, cheese-cloth, four glass tubes of one inch diameter five feet long, potato masher.

Materials—Clay, loam, sand and humous soil.

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Procedure—Over the top of each lamp chimney and glass tube tie a square of cheesecloth. With the potato masher and pie tin thoroughly pulverize a sample of each type of soil. Fill the lamp chimneys and the glass tubes, one with each type of soil. Jar each down until the soil is packed firmly. Suspend all of the lamp chimneys in the rack with the lower end of each hanging in a glass of water, or stand them in a pie tin of water. Stand each glass tube in a pie tin of water. (Fig. No. 9.) Renew the water supply as fast as each soil takes it up. At fifteen minute intervals measure the height to which the water has risen in each lamp chimney. Continue until four measurings have been taken or the water reaches the top. In each case note the exact time it takes the water to get to the top. After 72 hours measure the height of the water in the five foot tubes.

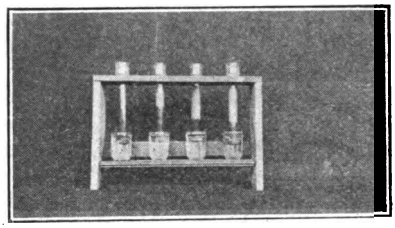

Fig. No. 9. Illustrating study number eight. The soils are from right to left: sand, sandy loam, humous soil and clay.

Compute the rate of capillarity for each type of soil.
Final height of capillary water_____
Time required in reaching height_____
Rate of capillarity per hour_____

Questions—1. In which soil did water rise the fastest? 2. In which soil did water rise the slowest? 3. How do you account for the different rates of capillarity? 4. What is the relation between capillarity and water loss by evaporation? 5. What is the relation between capillarity and the water needs of the plant?

*Study Number Nine.

The Porosity of Soils.

Apparatus—That used in Study Number Eight.
Materials—Sand, clay, loam, humous soil, and water.
Procedure—Fill the lamp chimneys as in Study Number Eight except that you fill only to the bulge at the base of the chimney. Suspend the chimneys in the rack and place an empty water glass under each. (Fig. No. 10.) Fill the bulge of each chimney with water, taking note of the time as you do so. Keep the bulge of the chimney filled with water until it drips at the bottom. Measure the depth to which the water has percolated every fifteen minutes.

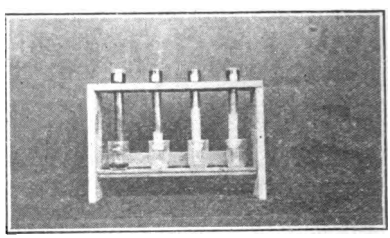

Fig. No. 10. Illustrating study number nine. The soils are from right to left: sand, sandy loam, humous soil and clay.

Compute the rate of percolation in each soil.
Distance of percolation in inches_____
Time required for percolation_____
Rate of percolation per hour_____

Questions—1. What are the conditions that make the difference in time for the percolation of water through the different soils? 2. Which soil would take in the most rainfall? 3. Which soil would possess the most water ten days after a rain? Explain.

NOTE.—Read carefully Study Number Nine-A before taking up Study Number Nine.

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*Study Number Nine A.

The Absorbent Power of Soils.

Apparatus—That used in Study Number Nine.

Materials—Those prepared in Study Number Nine and water leached from barnyard manure.

Procedure—In case this experiment is to be performed in connection with Study Number Nine use the water leached from barnyard manure to pour in on the top of the soils. Allow about a tablespoonful of water to drop through each soil. Compare the color of this water with that poured in at the top. Contrast the water that has run through each type of soil with each other sample.

Questions—1. What was the color of the water coming through each type of soil when compared with the original? 2. Which soil absorbed the most organic matter? 3. What can you say of the soil as a filter? 4. Can we safely count upon all underground water being free of organic matter?

Study Number Ten.

Soil Moisture at Various Depths.

Apparatus—Five soil pans, soil auger, balance and weights, five porcelain crucibles, drying oven.

Materials—To be obtained.

Procedure—Go out into the field and in soil pan No. 1 collect a sample of the top soil, in pan No. 2 soil at the depth of one foot, in pan No. 3 soil at the depth of two feet, in pan No. 4 soil at the depth of three feet, in pan No. 5 soil at the depth of four feet. Close each pan tightly as the soil sample is placed in it.

Take the weight of each soil sample and place in a drying oven for thirty-six hours. Reweigh and reserve for Study Number Thirteen.

Compute the per cent of moisture in each soil sample as follows:

Known weight of soil pan_____
Weight of pan and soil_____
Weight of pan and soil dried_____
Weight of moist soil _____
Weight of dry soil_____
Weight of water _____
Per cent of moisture_____

Questions—1. Which soil sample had the highest per cent of moisture? 2. How do you account for the conditions found? 3. Would there be any advantage in getting crops to root deep?

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*Study Number Eleven.

The Rate of Evaporation in Soils.

Apparatus—Balance.

Materials—Equally moist samples of clay, sand, loam, and humous soil.

Procedure—Set up the balance, fill the pans of the balance, one with moist clay and one with moist sand. Put the pans in exact balance and place the apparatus in

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a dry place. (Fig. No. 11.) Note the way in which the balance swings as the soils dry. Continue as above until you have checked every combination possible with the four soils.

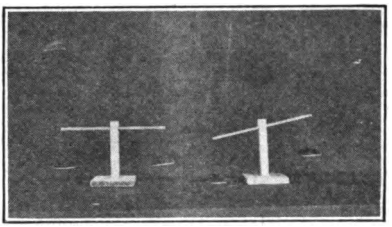

Fig. No. 11. Illustrating study number eleven.

Questions—1. What conditions did you find in the study above? 2. How do you account for them?

Study Number Twelve.

Hygroscopic Water.

Apparatus—Test tube, holder for same, Bunsen burner, small square of window glass.

Materials—Sample of dry road dust.

Procedure—Fill a test tube one-third full of dry road dust. Slowly heat it over the Bunsen flame. Hold the square of glass a little above the mouth of the test tube. Watch for moisture that may gather upon the sides of the test tube and the glass plate.

Questions—1. Did you succeed in driving moisture from the dry dust? 2. How was this moisture held in the dust? 3. Is this moisture of benefit to the plant?

Study Number Thirteen.

The Per Cent of Organic Matter in Soils.

Apparatus—Scales and weights, five porcelain crucibles, Bunsen burner.

Materials—Soil samples reserved from Study Number Ten.

Procedure—Get the soil samples reserved in Study Number Ten. Heat each soil sample to a dull red heat for one hour. When cool reweigh.

Compute the per cent of organic matter in each sample.

Weight of crucible_____
Weight of crucible and dry soil_____
Weight of crucible and burned soil_____
Weight of dry soil_____
Weight of burned soil_____
Weight of organic matter_____
Per cent of organic matter_____

The remaining material is mineral matter. Record the per cent of mineral matter in each case.

Questions—1. Which soil possessed the most organic matter? 2. What was the color of the soil possessing the most organic matter compared with the others? 3. What was the color of all of them when you finished burning them?

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Study Number Fourteen.

The Per Cent of Air in Soils.

Apparatus—Four water glasses, 2 graduate measures.

Materials—Dry samples of clay, loam, sand, humous soil.

Procedure—In each of the water glasses put a twenty-five c.c. sample of soil, in one sand, in one loam, in one clay and in one humous soil. In measuring the soil jar the graduate with the hand to pack the soil firmly. In each glass pour water slowly from a second graduate tube until it comes to the level of the top of the soil. Note carefully the number of c.c. of water taken for each soil. The water occupies the air space in the soil, giving you the air space in c.c.

Compute the per cent of air space for each soil type.

Volume of soil _____

Volume of water _____

Volume of air _____

Per cent of air space _____

Determine the air space in above types of soils secured under natural field conditions.

Questions—1. Is air in the soil necessary for plant growth? Explain. 2. Which soil contained the bigger per cent of air space? 3. Why is too much air space detrimental to plant growth? Too little?

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*Study Number Fifteen.

The Soil Types in Relation to Plant Growth.

Apparatus—Six small boxes 8" x 6" x 3" deep.

Materials—Sand, clay, humous soil.

Procedure—Take three of the boxes and fill them to within a half inch of the top: one with sand, one with clay, and one with humous soil. Water each well and place them in a warm, dry, well lighted place. Twenty-four hours later plant two dozen wheat grains in each box. Note the growth of the wheat from day to day. Water each box as needed, giving all the same treatment. (Fig. No. 12.)

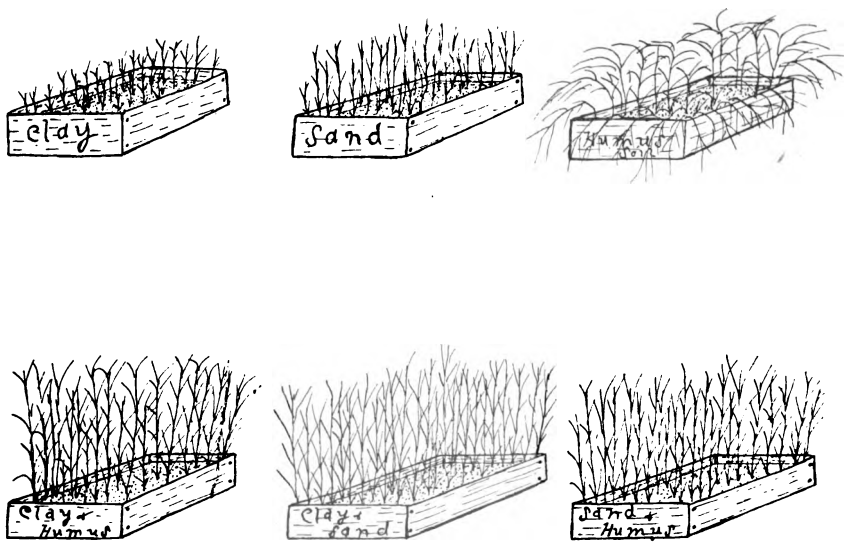

Fig. No. 12. Illustrating study number fifteen.

Take the remaining boxes and fill as above, one with a mixture half and half of sand and clay, one with a mixture half and half of clay and humous soil, one with a

mixture half and half of sand and humous soil. Treat these boxes as you treated those above.

Questions—1. In which soils did you secure the best growth? 2. Are the valuable farming soils found under natural conditions pure soils or mixtures? 3. In each case what was the trouble with the pure soil? 4. In each case how did mixtures differ in texture from the pure soils?

Study Number Sixteen.

*Contrasting Methods of Irrigation.

Apparatus—Four boxes 24" x 28" x 8" deep.

Materials—Moist loam soil, wheat seed.

Procedure—Fill the four boxes within one inch of the top. Pack the soil firmly. Plant three rows of seed in each box two inches in depth and three inches apart. Plant them the short dimension of the box. Prepare box No. 1 for sprinkling, No. 2 for flooding, No. 3 for furrowing and No. 4 for subirrigation. (Fig. No. 13.) Irrigate each box as needed until eight to twelve quarts are used upon each. Make note of and contrast plant and root growth in each box.

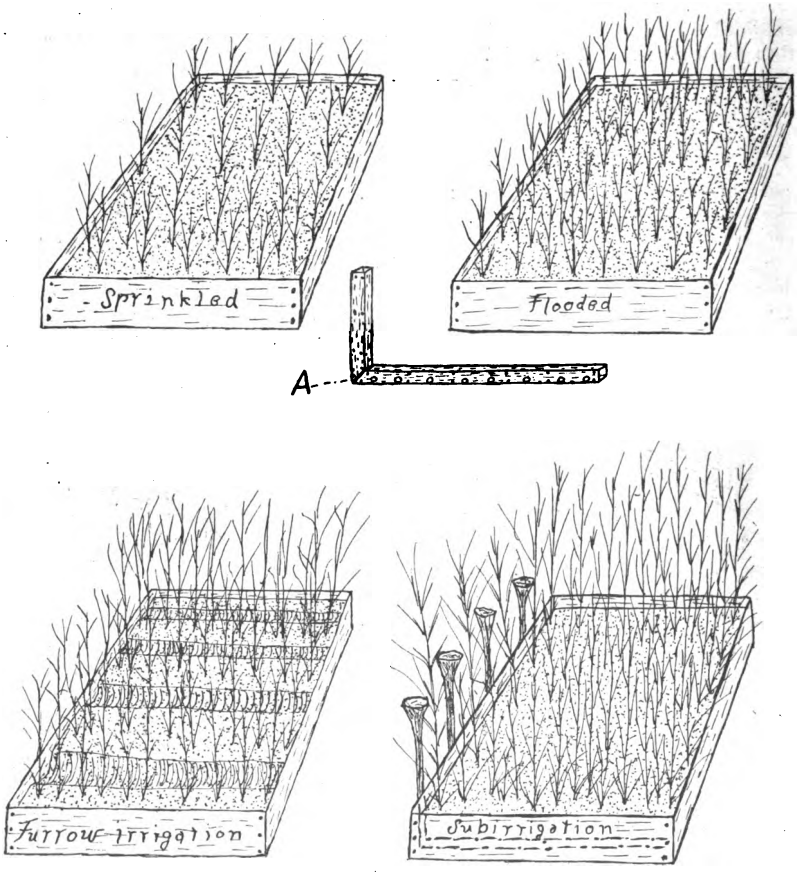

Fig. No. 13. Illustrating study number sixteen. Perforated lath tube at A used for sub-irrigation.

Questions—1. What conditions did you find under each method of irrigation? Which method proved the best? 3. Would this method be practical under all conditions? Explain.

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*Study Number Seventeen.

The Effects of Under Drainage.

Apparatus—Two five pound lard pails, thermometer.

Materials—Good loam soil, fine gravel, wheat seed.

Procedure—Punch a dozen holes in the bottom of one pail, put a half inch layer of gravel in each pail. Fill both to within an inch of the top with good loam soil. Pack the soil firmly in both by jarring the pails down. Plant a half dozen grains of wheat in each pail and water both thoroughly, using the same amount of water for each. In a half hour take the temperature of each and place them in a warm place. Give each can an equal amount of water whenever the plants in the drained can need water. After three weeks' growth dig up the plants in each can and compare them as to foliage and root growth. (Fig. No. 14.)

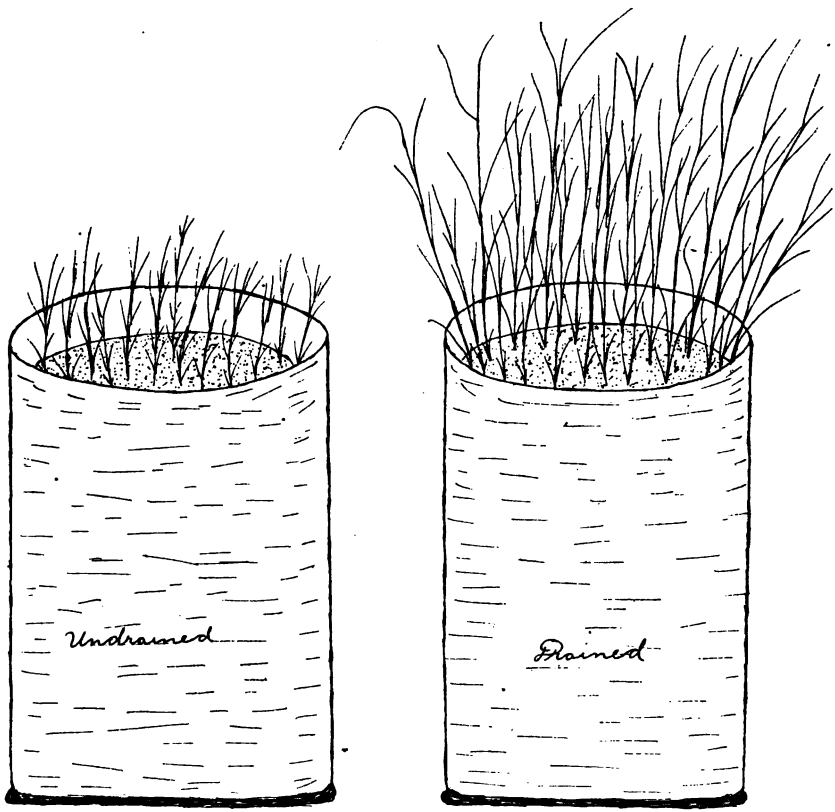

Fig. No. 14. Illustrating study number seventeen.

Questions—1. Which can of soil gave the best growth? 2. What conditions did you find in the poorly drained soil? 3. Why should land be well under-drained?

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*Study Number Eighteen.

Illustrating the Action of the Soil Mulch.

Apparatus—Shallow dish.

Materials—Four squares of lump sugar, powdered sugar, diluted solution of red ink.

Procedure—Cover the bottom of the dish an ½ of an inch deep with red ink solution, rub two of the lumps of sugar together to get close contact and then place them one on top of the other with the rubbed surfaces still together, in the red ink. (Fig. No. 15.)

Fig. No. 15. Illustrating study number eighteen. Layer of powdered sugar at A.

Treat the other two squares in the same way except that you put a ½ inch layer of powdered sugar between the two lumps.

Questions—1. What took place in the tests made above? 2. Would a finely powdered layer of soil over the surface of the ground act as did the powdered sugar? 3. What is the benefit of the soil mulch?

---

*Study Number Nineteen.

Testing the Action of the Soil Mulch.

Apparatus—Four two quart tin fruit cans, 4 pie pans, scales and weights.

Materials—Garden loam, sawdust or finely chopped straw.

Procedure—Punch a dozen holes in the bottom of each can. Number the cans 1, 2, 3, and 4. Fill cans 1, 2, and 3 within a half inch of the top with soil. Fill can 4 to within three inches of the top. Pack the soil firmly in each by jarring the cans down. Stand each in a pie tin of water until the surface becomes moist. Add water as it is taken up from the pan. As soon as the surface of the soil is moist remove the cans from the water and set them aside until the soil is dry enough to cultivate. Let the soil in can No. 1 remain as it is, cultivate the soil in No. 2 to the depth of two inches, the soil in No. 3 to the depth of three inches. On the soil of No. 4 put a three inch mulch of sawdust or straw. Weigh each can and place them in a dry, warm sunlighted window. Weigh each can daily for six days, making a record of each weight. After the last weighing dig into the soil in each can and note its moisture condition.

Questions—1. Which can lost weight the fastest? 2. Which can lost weight the least? 3. How do you account for the conditions found? 4. Is it worth while to keep a soil mulch upon the ground? 5. Would any other sort of mulch be practical under field conditions?

---

*Study Number Twenty.

Puddling.

Apparatus—Four quart tomato cans.

Materials—Clay, sand, loam and humous soil, wheat seed.

Procedure—Fill each can half full, one with clay, one with loam, one with sand and one with humous soil. Pour water in each and stir until the soil is of the consistency of a thick paste. Plant a half dozen grains of wheat in each can. Set them

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aside in the sunlight until the top of the soil in each can is dry, then bring indoors in a lighted room. After several days contrast soil conditions and plant growth in each type of soil.

Questions—1. Which soil puddled the worst? 2. Which soil puddled the least? 3. How do you account for the conditions found in the above study? 4. In which soil did the wheat grow the best? 5. What are the bad effects of puddling?

*Study Number Twenty-one.

A Field Trip.

Apparatus—Spade, rule, notebook for each student.

Materials—A clear mind, a good pair of eyes.

During the field trip the following points should be noted:

The geological origin of the soils of the region.

Make special note of the following: Evidences of the soil's origin. Different types of soil. Plant life growing on different soil types. Factors of soil formation.

Group the factors of soil formation under the following heads: Atmosphere, water and organic life.

Dig a hole several feet deep and compare as to color, texture and moisture the top soil and the soil at one, two, three and four feet deep.

Question—1. What is the geological origin of the soils in your neighborhood?

NOTE.—Write a report of the field trip telling of all things noted as outlined above.

*Study Number Twenty-two.

Moisture and Tillage.

Apparatus—Two small boxes, 6" x 8" x 3" deep.

Materials—Good loam soil.

Procedure—Fill each box with dry loam soil. Water each thoroughly and cultivate the soil in one vigorously at once. Set both aside and cultivate the second box of soil after 48 hours. Contrast the texture of the soil in each.

Questions—1. Why should a wet soil not be tilled? 2. What type of soil could be tilled soonest after irrigation. (Study Number Twenty.)

Study Number Twenty-three.

The Water Holding Capacity of Soils.

Apparatus—Scales and weights, 4 funnels, filter paper, cubic centimeter measure.

Materials—Sand, clay, loam and humous soil.

Procedure—Place the funnels in a rack. In each funnel put a sheet of filter paper. Moisten each piece of filter paper and allow each to drain until water ceases dripping from the funnel. Under each funnel place a dry beaker. In each funnel put 25 c.c. of soil, in one loam, one sand, one clay and in one humous soil. To each add slowly 25 c.c. of water and let them drain until water ceases dripping from the funnels. Measure the number of cubic centimeters of water that dripped from each sample.

Compute as follows:

Volume of soil _____

Volume of water _____

Water holding capacity _____

Questions—1. Which soil held the most water? 2. Which soil held the least water? 3. How do you account for the conditions observed above?

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*Study Number Twenty-four.

Some Conditions Affecting Soil Temperature.

Apparatus—Four small boxes, thermometer.

Materials—Loam, lime or chalk dust.

Procedure—Fill each of the four boxes to within an inch of the top with moist loam. Water one box thoroughly. Over the surface of one sprinkle a thin layer of lime or chalk dust. Place these boxes in the sunlight, three so that they face the south, two of these being the wet soil and the soil with the lime covering, and one facing the north in imitation of a north slope.

Take the temperatures of these soils for two bright sunshiny days at 8 o'clock, 10, 12, 2 and 4.

Questions—1. What temperature conditions did you find in each case above? 2. Which soil absorbs the most heat, light or dark? 3. Why is a damp soil cold? 4. Which slope would warm up earlier in the spring, a south or a north?

---

*Study Number Twenty-five.

Effects of Lime Upon the Soil.

Apparatus—Pint jar, 2 six ounce bottles, 2 pie tins.

Materials—Clay, lime.

Procedure—(*a*) Fill the pint jar with water. Put two spoonfuls of fine clay in it and stir thoroughly for three or four minutes. Let the mixture settle for five minutes. Fill the two bottles with water from the jar, taking care not to stir up the sediment collected at the bottom. Into one bottle put a piece of lime the size of a bean and shake the contents well. Shake the other bottle thoroughly. Set the two bottles aside for twenty-four hours, occasionally taking note of any changes that may occur.

(*b*) Fill the pie tins three-fourths full of fine clay soil. To one add two teaspoonfuls of lime. Add water to both and stir until they are of a thick pasty consistency. Set them aside where they will dry. When dry remove the hardened soil and pulverize some from each pan. Note the effort needed to pulverize each.

Questions—1. What changes took place in the bottles prepared in section (*a*)? 2. What caused this? 3. What conditions did you find in the soils prepared in the pans? 4. What results could be expected from putting lime on a stiff clay soil? 5. Would it be practical to do this always? Explain.

Study Number Twenty-six.

Some Principal Ingredients of White and Black Alkali.

Apparatus—Three quart tin cans, 3 pie tins.

Materials—Clay loam, sodium carbonate, sodium chloride, sodium sulphate.

Procedure—Fill the cans to within a half inch of the top with dry finely pulverized clay loam. Label the cans 1, 2, and 3. In a pie tin mix with the soil in can No. 1 fifteen grams of well powdered sodium carbonate ($NA_2\ CO_3$) and return to the can. In the same way mix in the soil in can No. 2 eight grams of sodium chloride (NA Cl) and eight grams of sodium sulphate ($NA_2\ SO_4$). Add enough water to all three cans to saturate the soil. Thoroughly pack the soil in each can and place them in a warm place for a few days. Note results. Can No. 3 serves as a check. Contrast the surface of the soil in the cans with the surface of alkali soils under natural conditions.

Questions—1. What comes about as the cans of soil dry? 2. What are the differences in the incrustations in cans 1 and 2? 3. How is alkali brought to the surface?

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Study Number Twenty-seven.

The Gypsum Treatment for Black Alkali.

Apparatus—Quart tin can, pie tin.

Materials—Sodium carbonate, calcium sulphate (land plaster).

Procedure—Fill the can to within a half inch of the top with well pulverized clay loam. Mix thoroughly into it 15 grams each of sodium carbonate ($NA_2\ CO_3$) and calcium sulphate ($CA\ SO_4$). Slowly add water to the soil until it is saturated. Compact the soil thoroughly and place it in a warm place in the laboratory. After several days' drying note conditions.

Questions—1. What conditions do you find here? 2. What has become of the black alkali? (NOTE.—The sodium carbonate reacts chemically with the calcium sulphate, to form insoluble calcium carbonate and sodium sulphate.) 3. Would the gypsum treatment of black alkali land be practical under all conditions?

---

*Study Number Twenty-eight.

Cropping and Draining White Alkali Soils.

Apparatus—Three boxes 3′ x 2′ x 1′ deep, spade, drain tile.

Materials—White alkali soils, alfalfa, sugar beet, tobacco, barley, wheat and oat seed.

Procedure—Fill the boxes to within three inches of the top with moist alkali soil. Label the boxes 1, 2, and 3. Arrange the drain tile to thoroughly drain box No. 1. In box No. 2 plant a row each of tobacco, sugar beets and alfalfa. In box No. 3 plant a row each of wheat, barley and oats. Flood box No. 1 with three inches of water every day for four days. When the soil is in proper condition for planting, plant a row each of barley, oats and wheat. Irrigate the soil in each box as the plants need and watch their growth for a month. (Fig. No. 16.)

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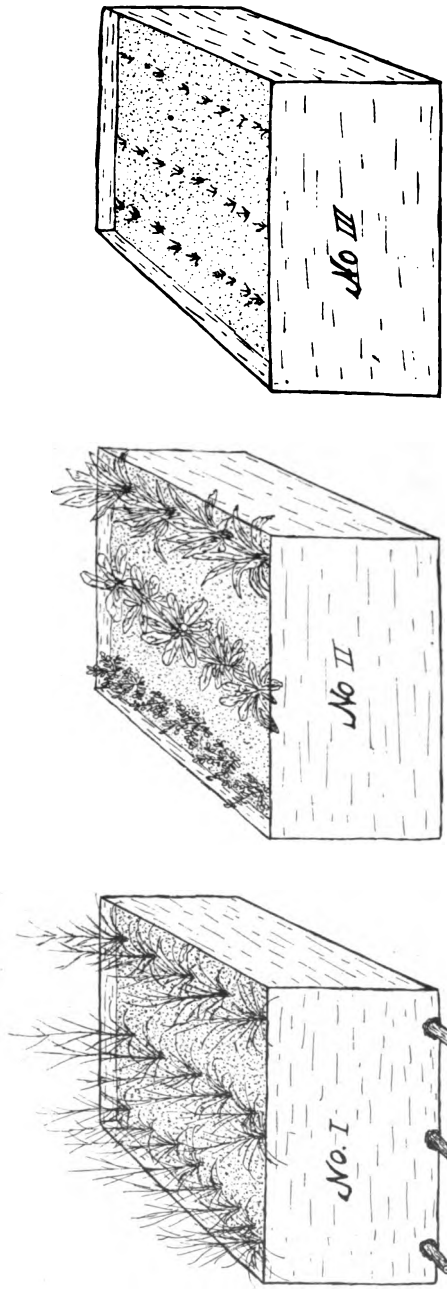

Fig. No. 16. Illustrating study number twenty-eight.

Questions—1. What conditions do you find in each box? 2. How do you explain these conditions? 3. What sort of crops would you call alfalfa, tobacco and sugar beets?

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Study Number Twenty-nine.

Tests for Alkali Soils and Acid Soils.

Apparatus—Three pie tins, red and blue litmus paper.

Materials—To be obtained.

Procedure—Collect soil samples from alkali soils, and from boggy soil and poorly drained heavy clay soil. Put a handful of each in separate pans. Put in each soil sample small strips of red and blue litmus paper. Moisten each with distilled water and press the soils down firmly about the paper. Allow them to stand an hour or two. Remove the litmus papers and wash them thoroughly with distilled water and dry them. When dry examine them and compare the color of each with the original litmus paper. "Black alkali" will turn the red litmus to blue. Acid soils will turn blue to red.

Questions—1. What results did you get in the above study? 2. What are the physical appearances of an acid soil? Of an alkali soil? 3. Judging from past studies, how could each be corrected?

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*Study Number Thirty.

The Composition of Loam.

NOTE.—Section (a) of this study can be taken up without the microscope and is a complete and interesting study in itself.

Apparatus—Three pint fruit jars, microscope.

Materials—Loam.

Procedure—(a) Fill a fruit jar two-thirds full of water and in it put three tablespoonfuls of loam. Screw on the top and shake the jar vigorously for two minutes. Set it aside for twenty-four hours and during this time shake the jar occasionally.

After twenty-four hours give the jar a vigorous shaking for five minutes. Set the jar on a level surface. Allow to settle one minute. Carefully pour the roily water into another jar. Let this settle one hour. Pour off the roily water and evaporate in a drying oven. (Fig. No. 17.)

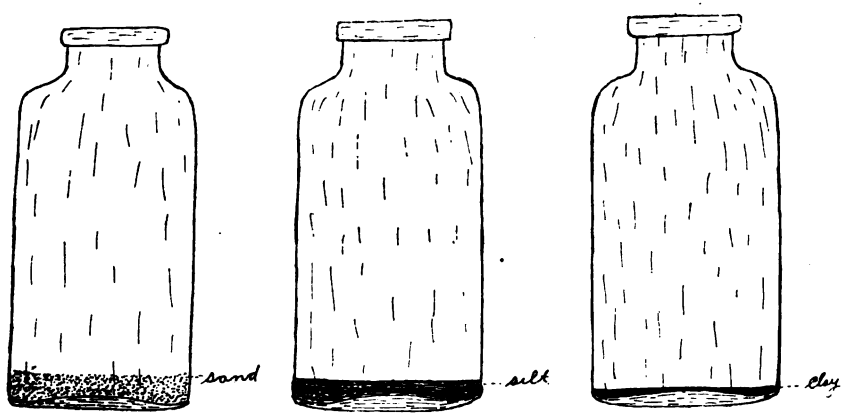

Fig. No. 17. Illustrating section (A) of study number thirty.

When the three soil settlings are dry examine the separates. The first settling is sand, the second silt, the third clay. (Each will contain some organic matter.) Examine each to note differences in texture. Which ones would puddle easily? Would pure sand or pure clay make a good soil?

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(*b*) Examine the sand under the microscope with a magnification of fifty diameters.

Mix a little silt with water and examine a drop under the microscope, magnifying 100 diameters. Do the same with clay, magnifying 500 diameters. Note what the soil particles are in each soil type. Make drawings of each type as it appears under the microscope. In each case find black particles of humus and draw them separately.

Look for flocculated particles of clay (a number of particles united to form a compound particle). The keeping of the soil in a good condition is largely a matter of keeping the soil particles well flocculated.

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*Study Number Thirty-one.

The Effects of Plowed-Under Manures Upon Capillarity.

Apparatus—Three student lamp chimneys, 3 water glasses, rack, cheesecloth, rubber bands.

Materials—Dry loam, straw, well rotted manure, hard lumpy clay.

Procedure—Fasten a square of cheesecloth over the small end of each lamp chimney with a rubber band. Fill each two-thirds full of dry loam. Jar the lamp chimneys with the hand to pack the soil. Label them 1, 2 and 3. On the soil in No. 1 put an inch layer of finely chopped straw, in No. 2 an inch layer of well rotted manure and in No. 3 an inch layer of hard clay lumps the size of a pea. Put in each chimney two inches more of dry loam. Put the lamp chimneys in the rack with each dipping into a glass of water. Note the rise of water by capillarity. (Fig. No. 18.)

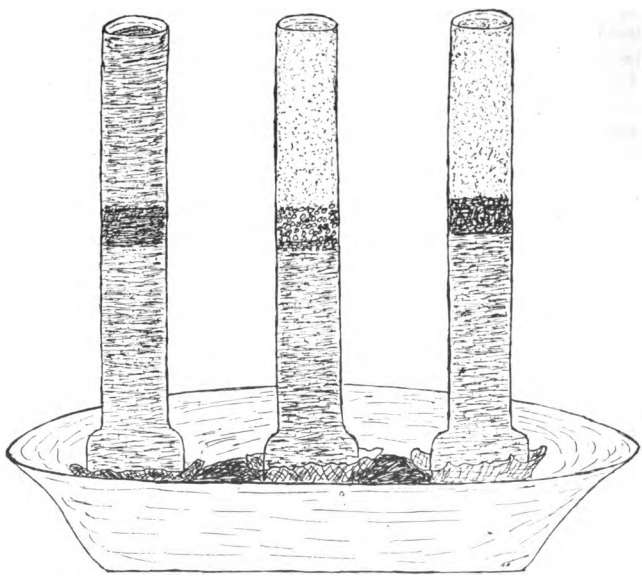

Fig. No. 18. Illustrating study number thirty-one.

Questions—1. Through which does the water pass the fastest—the straw, clay lumps or well rotted manure? 2. If the top soil were the furrow slice and straw, manure and clods represented material plowed under, in which would newly planted crops do the best? Explain. 3. When should coarse strawy manure be plowed under? 4. When should hard dry soil be plowed? 5. Is it safe to plow under well rotted manure at any time? Explain.

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*Study Number Thirty-two.

Farm Fertilizers.

Apparatus—Four boxes 8" x 6" x 3" deep, meat grinder or a chopping knife.

Materials—Sandy soil, green alfalfa or clover, green wheat or rye, rain water, well rotted barnyard manure.

Procedure—Fill the boxes to within an inch of the top with moist sandy soil. Label them 1, 2, 3, and 4. Treat soil in box No. 1 as follows: Over the top of the soil spread a half inch layer of green clover or alfalfa pulp. (To make this pulp secure some succulent clover or alfalfa, roots and all, and wash the dirt from them and run them through a meat grinder or chop them to a pulp with a chopping knife. Take special care to keep the plant juice with the pulp.) Mix the pulp thoroughly with the soil. Treat the soil in box No. 2 as above with a pulp made from green rye or wheat. Treat box No. 3 with a half inch layer of well pulverized, moist, fresh barnyard manure. Leave box No. 4 to serve as a check. Put all of the boxes in warm well lighted place and water each with distilled or rain water. Never add more water than the soil can take up, that is, do not add water until it drips from the box. After forty-eight hours plant three dozen grains of wheat in each box. Water each box as needed and watch growth for a month or six weeks. (Fig. No. 19.)

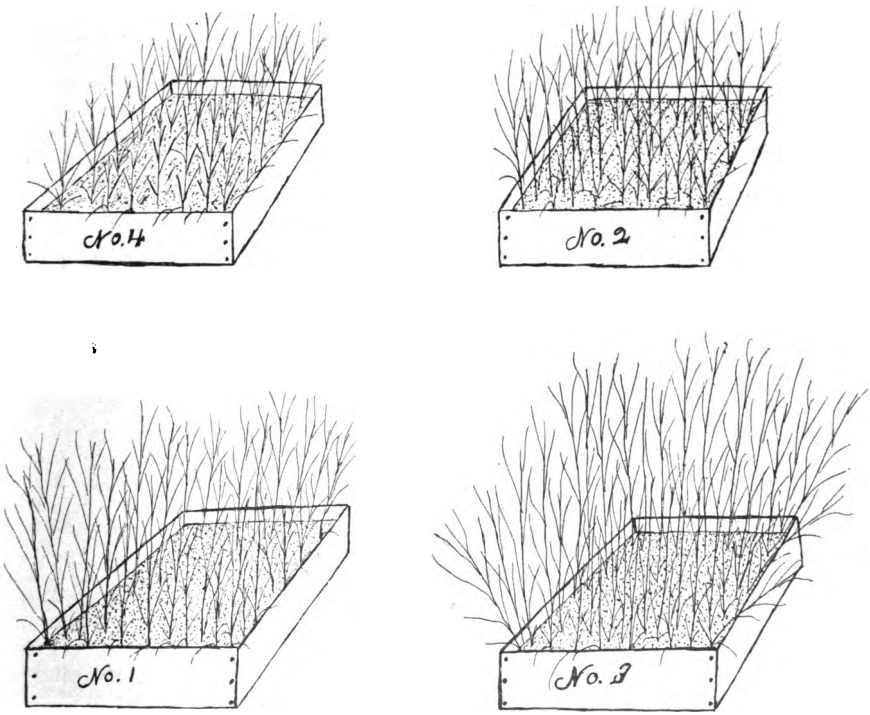

Fig. No. 19. Illustrating study number thirty-two.

Questions—1. What conditions of growth did you observe in each box? 2. If you are going to plow under green crops, what sort are best? 3. Would other legumes, as cowpeas or soy-beans, be as good as alfalfa or clover? 4. Which would pay best, to plow under a green crop or let the crop mature, feed it to animals, and return the manure from the crop to the land?

Problem—The average farm animal returns about 70 per cent of its food as manure. A ton of alfalfa hay would make how much barnyard manure?

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PLANT STUDIES.

Study Number One.

The Elements Used as Plant Food.

The elements used as plant food are carbon, calcium, aluminum, iron, phosphorus, potassium, magnesium, sulphur, sodium, silicon, hydrogen, oxygen, nitrogen and chlorine.

Procedure—From the laboratory reference books look up and record the properties of the elements given above.

Questions—What is an element? What is a compound? In what form do most elements exist?

Tell in what form or forms the above elements exist and of their abundance.

NOTE.—After you have finished the following studies to and including Study Number Forty-four, return to this experiment and with the aid of your above notes tell the source of each element above as plant food and how it is obtained and appropriated by the plant.

Study Number Two.

The Mineral Matter in Plants.

Apparatus—Three porcelain crucibles, Bunsen burner.

Materials—Dry plant, piece of meat, loam soil.

Procedure—Take a dry plant, place it in a crucible and burn it as completely as possible. Is there anything left? What do you call it? It is composed of the mineral matter of the plant body. The process of burning is what sort of a chemical change? What becomes of the elements composing the major portion of the plant body?

Treat a piece of meat as you did the dry plant. Can you burn it entirely away?

Put some loam in a crucible. Treat it as you did the plant. Take note of results during the burning.

Questions—1. What do you suppose is the use of the mineral matter in the plant body? The animal body? 2. Where do plants get their mineral matter? 3. Where do animals get theirs? 4. What becomes of the plant and animal body after death?

Study Number Three.

The Water in Plants.

Apparatus—Scales, weights, drying oven, knife.

Materials—Young green plant, apple, potato, piece of meat.

Procedure—Weigh a green young plant, a peeled apple or potato and a piece of meat. Put all in the drying oven for twelve hours. Reweigh. Record the loss of weight in each case.

Questions—1. What was the loss of weight in each case above? 2. What caused the decrease of weight? 3. What uses do plants and animals make of water?

Problem—In each case compute the percentage of water loss.

Original weight _____

Weight after drying _____

Per cent of loss _____

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Study Number Four.

Carbohydrates (Starch).

Apparatus—Test tube, mortar and pestle, Bunsen burner, medicine dropper.

Materials—Starch, iodine.

Procedure—Grind the starch with a mortar and pestle. In the bottom of a test tube place a quantity of starch the size of a large pea. To this add a half test tube of water. Heat slowly until the water is quite warm to the touch. Add a few drops of solution of iodine.

Question—1. What change do you note? A black color indicates an excess of starch.

Starch is a compound of hydrogen, carbon and oxygen. The above procedure is the usual test for starch.

Study Number Five.

Carbohydrates (Grape Sugar).

Apparatus—Test tube, Bunsen burner.

Materials—Glucose, Fehling's solution.

Procedure—Put a ball of glucose the size of a bean in a test tube one-fourth full of water. Shake until the glucose is dissolved. Add two-thirds the amount of Fehling's solution and boil.

Question—1. What change in color takes place in the solution?

Should grape sugar be present in any substance treated as above, the contents of the tube will turn either a yellowish brick red or deep orange color.

The above is the usual test given for grape sugar. It is a compound of the elements carbon, hydrogen and oxygen.

Study Number Six.

Fats and Oils.

Apparatus—Watch glass, mortar and pestle.

Materials—English walnut, almond, flax seed, ether.

Procedure—Take a small piece of animal fat and crush it on a piece of white glazed paper. Hold the paper up to the light and note results. Do the same with a kernel of an English walnut; of an almond.

Grind up with mortar and pestle some flax seed, place a fourth of a teaspoonful in a watch glass, add ether and allow it to stand until it evaporates. Note what is left. Ether dissolves and separates oils from substances and in evaporating leaves the oil on the container. The above are usual methods for testing for fats and oils.

Fats and oils are composed of carbon, hydrogen and oxygen.

Study Number Seven.

Proteids.

Apparatus—Test tubes, mortar and pestle.

Materials—Egg, nitric acid, ammonia, wheat.

Procedure—Place a little white of an egg (raw) in a test tube. To this add a little nitric acid. Note any change of color. Rinse the material in the test tube with water and pour in a little ammonia. Note any change of color. Grind up a few grains of wheat and test as above. Do the same with corn. Note results. A greenish yellow, and a lemon yellow or a deep orange color indicates proteids.

Drop a little of the raw white of an egg in a test tube of boiling water. Note what takes place. A coagulation indicates a proteid called albumen.

The above are the usual tests for proteids. Proteids are composed of carbon, hydrogen, nitrogen and oxygen.

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Study Number Eight.

A Summary of Previous Studies.

Apparatus—Test tubes, mortar and pestle, Bunsen burner, porcelain crucibles, scales and weights.

Materials—Potato, wheat, bread, meat, iodine, ammonia, nitric acid, ether, Fehling's solution.

Procedure—Test each of the following materials for starch, fats and oils, grape sugar, mineral matter and water:

	Bread	Potato	Wheat	Meat
Proteids				
Fats and oils				
Starch				
Grape sugar				
Minerals				
Water				

*Study Number Nine.

The Flower.

Apparatus—Set of dissecting tools, microscope, slides, cover glasses.

Materials—Several flowers.

Procedure—(*a*) Take one of the flowers. Note the bright conspicuous part of the flower. This is named the corolla. Its separate leaves are called petals. Note the number of petals.

(*b*) Pull off the petals of the corolla. Note the little green bowl-like base (calyx). Note the little green leaves attached to calyx (sepals). Note the little spike-like growth extending up from the center of the calyx (pistil). Note the little thread-like growths growing up from the inner sides of the calyx or from the pistil (stamens).

(*c*) Note three distinct parts of the pistil. Draw and label each part. Make a drawing of the stamen and label each part.

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Take a second flower, make a longitudinal section of it and draw the flower as seen thus, labeling all parts. (Fig. No. 20.)

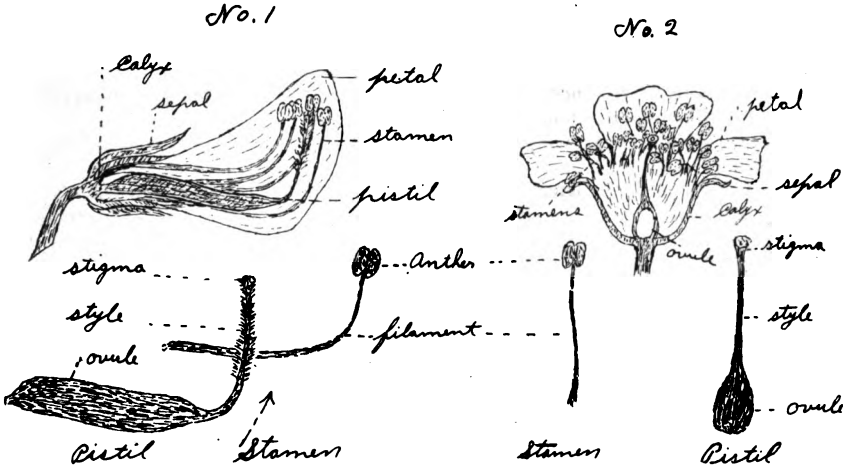

Fig. No. 20. Illustrating study number nine.
1.—The flower of the sweat pea.
2.—The flower of the cherry.

(*d*) Secure a high power microscope and make and examine a slide of pollen grains. Draw them as seen.

Make a longitudinal slide of the calyx and examine the same. Draw and label parts as seen.

Put a few pollen grains in a drop of growing solution on a microscope slide. Keep the slide in a moist air chamber. Examine daily, taking note of the growth of the pollen grain.

(*e*) Collect a number of different kinds of flowers and identify the parts of the flower in each. Make a drawing of a longitudinal section of each flower, labeling parts.

Questions—1. What are the functions of the following: corolla, calyx, style, ovule, stigma, filament, anther and pollen? 2. What does the pistil consist of? The stamen? 3. How does the pollen grain fertilize the ovule? Illustrate by drawing.

Study Number Ten.

The Types of Fruits.

Apparatus—Knife.

Materials—Fruit of the following plants: wheat, oats, walnut, maple, elm, bean, pea, alfalfa, plum, peach, melon, squash, blackberry, currant and orange.

Procedure—Classify the above fruits (first) as dry and fleshy, (second) the fleshy fruits as drupe, accessory, aggregate and berry, (third) the dry fruits as dehiscent and indehiscent.

Make a drawing of the cross section of the following and show the parts that developed from the endocarp, exocarp and the ovule.

It is the function of the flower to produce the fruit. Tell briefly of the economic importance of plant fruits.

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*Study Number Eleven.

The Structure of the Seed.

Apparatus—Set of dissecting tools, dissecting microscope, two plates, blotting paper.

Materials—Seed of the corn and of the bean that have been soaked twenty-four hours, dry seeds of the corn and the bean.

Procedure—Making a drawing of the bean seed showing the radicle ridge, micropyle, hilum and rophe.

Split a soaked bean the long way by inserting the point of the knife just below the raphe and running it around the bean to the side opposite the hilum. Make a drawing indicating the seed coat, the cotyledons, the radicle, the hypocotyl, the plumule.

Cut off one-fourth inch of the pointed end of a soaked grain of corn. Make a drawing of the cross section thus obtained, indicating the seed coat, cotyledon, endosperm and radicle.

Split a grain of corn in halves the long way. Make a drawing of the cross section thus obtained showing seed coat, radicle, plumule, hypocotyl, cotyledon and endosperm. (Fig. No. 21.)

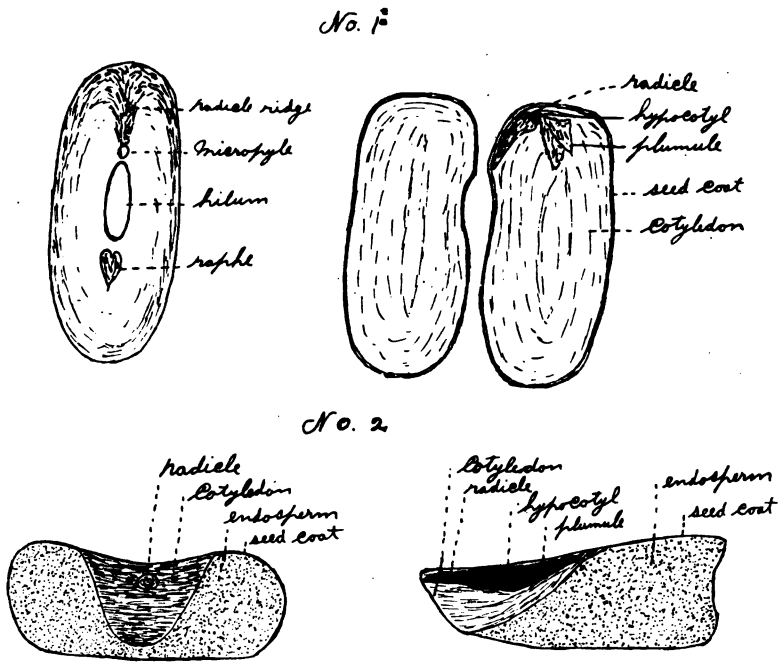

Fig. No. 21. Illustrating study number eleven.
No. 1.—The parts of the bean seed.
No. 2.—The parts of the corn seed.

Plant a half dozen dry bean seeds and a half dozen dry corn seeds in damp sand. Place them in a warm place until they germinate. Note several times each day the difference in plant structure and processes of germination as each germinating seed presents the young plants to view. Illustrate by drawings.

Plant in damp sand a few of each of the following seeds and class them either with the class represented by the bean seed or by the corn seed:

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Wheat, pumpkin, squash, radish, cabbage, oats, rye, turnip, alfalfa, bluegrass, clover and onion.

Questions—1. Are we justified in speaking of the seed as an embryo plant? Explain. 2. What is the function of the following: micropyle, hilum, seed coat, radicle, hypocotyl, plumule? 3. Plants bearing seeds similar to the bean are given what name or classification? Similar to the corn seed? 4. In what class do our important food grains come?

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*Study Number Twelve.

The First Step in Seed Germination.

Apparatus—Glass tumbler or beaker, Bunsen burner, ring-stand, 250 c.c. flask and cork to fit flask.

Materials—Water and half dozen Windsor beans.

Procedure—Fill the 250 c.c flask half full of water and heat over the Bunsen burner until it boils. Note what takes place as the water begins to get warm. When the water reaches the boiling point cork the flask and set it aside. Allow the water to cool until quite warm and into it drop the Windsor beans. Note what takes place. (Fig. No. 22.)

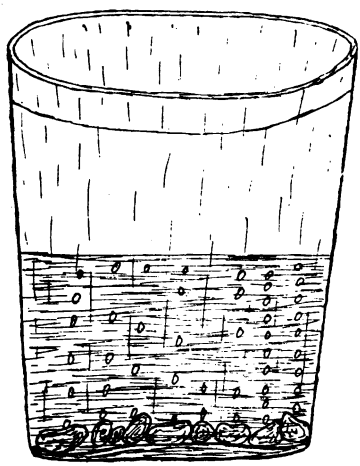

Fig. No. 22. Illustrating study number twelve.

Questions—1. What formed the tiny bubbles seen as the water got warm? 2. What caused them to rise? 3. How did this air come to be in the water? 4. What class of plants make use of the air in water? 5. From what part of the seed did bubbles rise? 6. What caused the bubbles to form? 7. How does the water first enter the germinating seed?

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*Study Number Thirteen.

The Function of the Cotyledon and Endosperm.

Apparatus—Two small boxes, knife.

Materials—Sand, bean seed and corn seed that has been soaked twenty-four hours.

Procedure—Plant three rows of beans in a box of sand. As the beans break through the soil pinch off both cotyledons from one row of plants, one cotyledon from each plant in the second row and let the plants in row three grow normally. Water the plants as needed. (Fig. No. 23.)

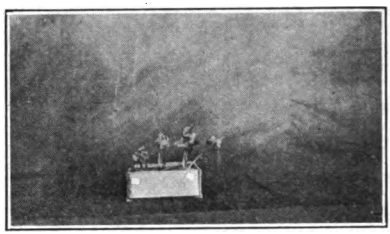

Fig. No. 23. Illustrating study number thirteen.

Plant in the second box a row of plump corn seed and a row of seed soaked for twenty-four hours from which the endosperm has been cut. Note how each grows.

Questions—1. In each case above, which plants made the best growth? 2. What is the function of the cotyledon? Of the endosperm?

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*Study Number Fourteen.

The Processes of Seed Germination.

Apparatus—Pie tin, two glass plates 4" x 4", blotting paper, two heavy rubber bands.

Materials—Water, half dozen grains of wheat, half dozen seeds of radish.

Procedure—Clean both plates of glass thoroughly. On one place the radish seed. scarred side down, in a row near the top. Over these place a half dozen thicknesses of blotting paper 4" x 4" square. On the blotting paper place the grains of wheat in a row near the top grooved side up and over these place the second glass plate. Place rubber bands tightly around the pack, one near the top and one near the bottom. (Fig. No. 24.)

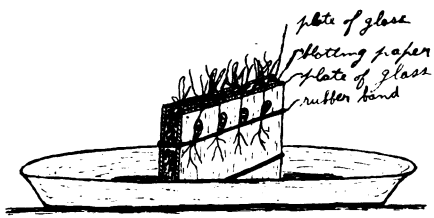

Fig. No. 24. Illustrating study number fourteen.

Fill the pie tin part full of water and set the seed pack on end in the water with seeds at the top. Put in a warm, well lighted place. Renew the water supply in

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the pan each day and carefully watch the root growth for ten days or two weeks. (Fig. No. 24a.)

Questions—1. What part of the young plant broke the seed coat first? 2. Is there any tendency of the roots to grow into the blotter? What causes this?

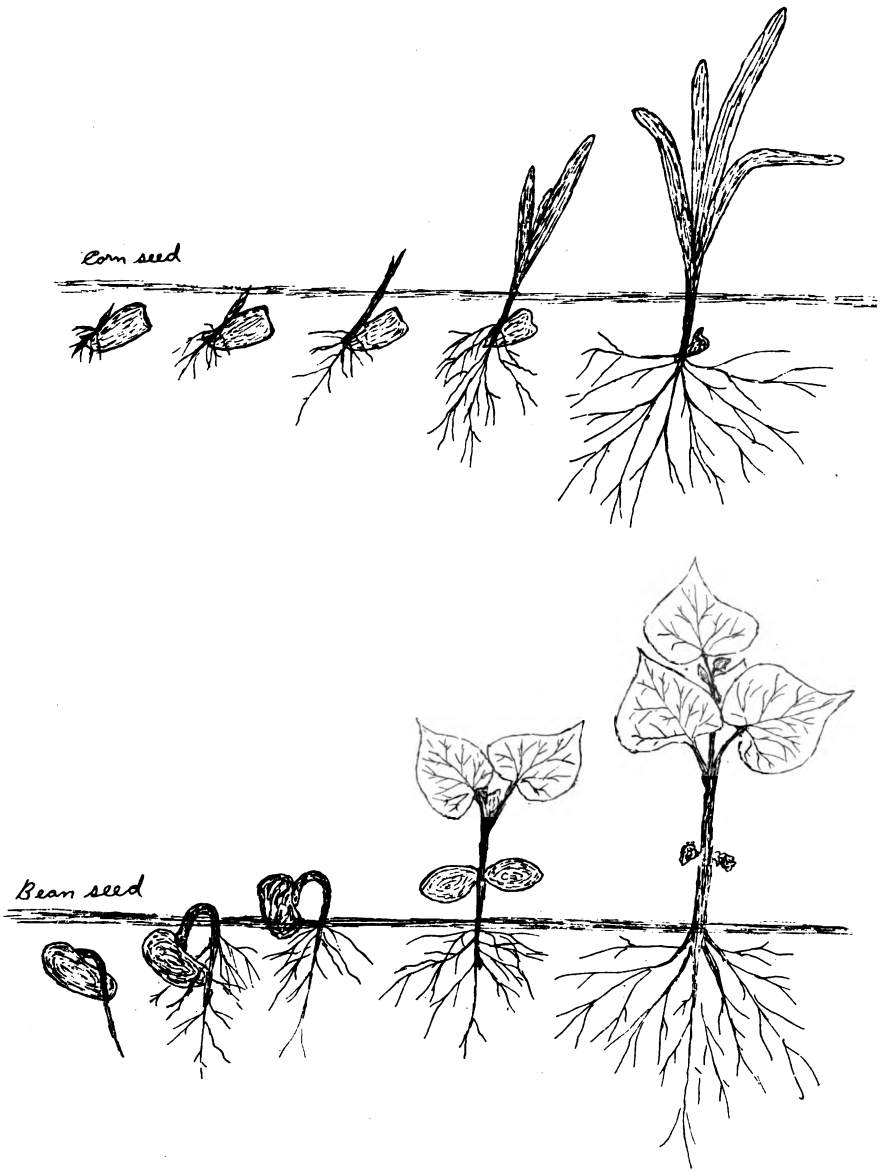

Fig. No. 24a. Illustrating study number fourteen. Five stages in seed germination.

3. What was the color of the seed leaf when it broke the seed coat? 4. How long was it in changing color? 5. What has this color to do with plant growth? 6. What becomes of the seed as the plant grows? 7. When is a young plant capable of taking care of itself?

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Study Number Fifteen.

Preparation of Oxygen.

Apparatus—Ring-stand, several test tubes, rubber tubing, four wide-mouthed bottles, four glass plates, pneumatic trough, Florence flask.

Materials—Potassium chlorate, manganese dioxide, taper or splinters of wood.

Procedure—Set up the apparatus for preparing oxygen (Fig. No. 7). Mix thoroughly 8 grams of potassium chlorate and 6 grams of manganese dioxide. Place it in a Florence flask for heating, which is connected with a rubber tube for the collection of the gas over water. Heat the test tube carefully in a way to secure a gentle evolution of the gas. Collect several bottles of the gas and test each with a glowing splinter. Note what takes place.

Questions—1. What took place when the glowing splinter was put in the oxygen gas? 2. Could you justly call the phenomenon seen above a reliable test for an excessive presence of oxygen?

Study Number Sixteen.

Preparation and Properties of Carbon Dioxide.

Apparatus—Florence flask, stopper, delivery tube, thistle tube, three wide-mouthed bottles, rubber tube, pneumatic trough.

Materials—Marble chips, lime water, hydrochloric acid, splinter, candle.

Procedure—Put a few marble chips into the Florence flask equipped with two-holed stopper, thistle tube and delivery tube. (Fig. No. 7.)

Pour in enough water to cover the marble chips and then add an equal amount of hydrochloric acid. Collect three bottles of the carbon dioxide gas over water.

Invert a bottle of the gas over a lighted candle. Thrust a glowing splinter into one bottle. Pour a little lime water into the third bottle. Take careful note of the results in each case.

Questions—1. What results did you get in the test with lime water? With the lighted candle? 2. Are you justified in considering the above phenomenon a reliable test for carbon dioxide gas?

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*Study Number Seventeen.

What Do Germinating Seeds Take From the Air and Return?

Apparatus—Two pint bottles.

Materials—Bean seed, splinter.

Procedure—Soak six dozen bean seeds for twenty-four hours. Put them in one of the pint bottles and close it airtight. Also close the other bottle airtight. Leave the bottles thus for forty-eight hours. Carefully open each bottle and in it thrust a burning splinter at the time of opening. Close immediately. Open again and into each pour a little lime water. (Fig. No. 25.)

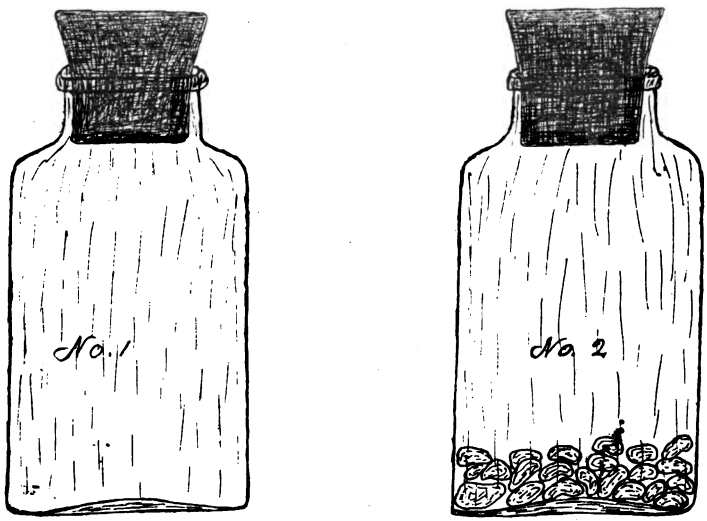

Fig. No. 25. Illustrating study number seventeen.
No. 1.—Empty bottle serving as a check.
No. 2.—Bottle with germinating seeds.

Questions—1. What happened to the burning splinter in each case? 2. How do you account for the results obtained? 3. What did the seeds take from the air? 4. What use did the seeds make of the oxygen? From where did the excess of carbon dioxide come? Explain.

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*Study Number Eighteen.

The Need of Oxygen for Germination.

Apparatus—Two pint bottles, rubber stopper to fit bottles, and clean sand.

Materials—Water and six dozen grains of wheat.

Procedure—Fill each bottle an inch in depth with very moist sand packed quite firmly. On the sand in each bottle scatter three dozen grains of wheat. (Fig. No. 26.) Cork one bottle tightly and leave the other open. Place both bottles in a warm place. Note results from day to day. After ten days or two weeks test the corked bottle with lime water.

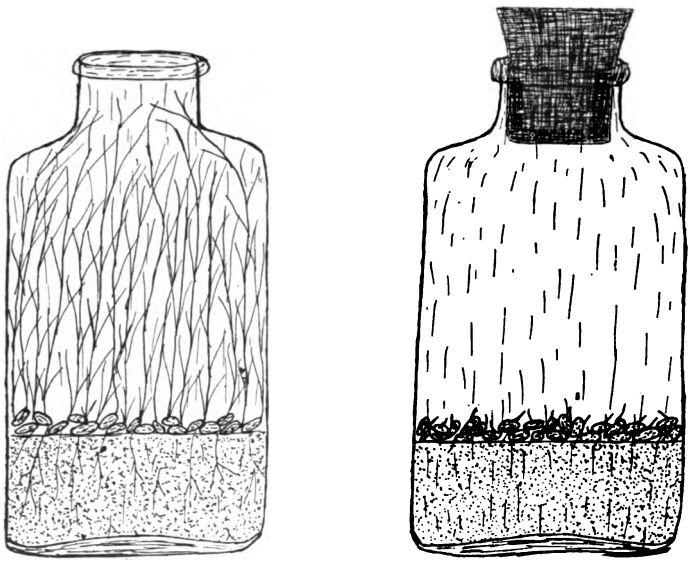

Fig. No. 26. Illustrating study number eighteen.

Questions—1. What difference in growth do you find in each bottle? 2. What is the cause of this difference. 3. What need does this show for seed germination? Where do the seeds covered in soil get oxygen?

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*Study Number Nineteen.

The Root Hairs.

Apparatus—Microscope or hand lens.

Materials—Seeds that have been germinated between blotters; young seedling.

Procedure—(*a*) Take a newly germinated seed possessing the seed leaves fully exposed and a root one to two inches in length. Note the mold-like growth a short distance back of the tip of the root. Put the root under a lens or microscope and examine this mold-like growth. These are root hairs. Isolate one and examine it under the scope. Draw the single root hair as you see it. Make a complete drawing of the plant showing seed leaves, stem, root and root hairs. (Fig. No. 27.)

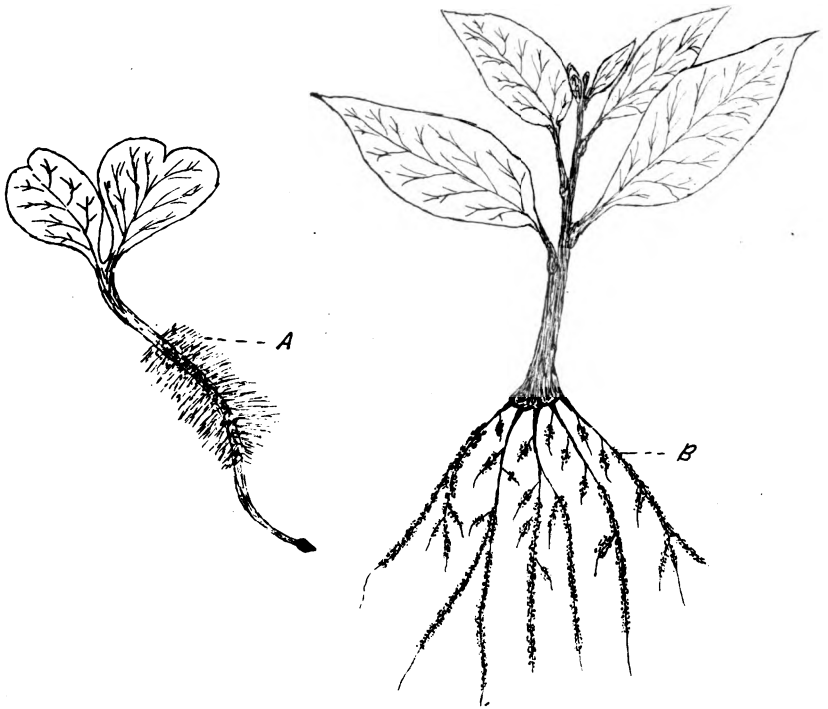

Fig. No. 27. Illustrating study number nineteen.
A—Root hairs on a young radish.
B—Root hairs clinging to soil particles

(*b*) Pull a young seedling that has been growing in clean sand. Note how the sand adheres to the small roots. Draw the young plant and root system as seen. Place one of the smaller roots under the microscope. Make a drawing of the root and soil particles as they appear under the scope.

Questions—1. What is the function of the root hairs? 2. By what process do they perform this function? 3. In section (*b*) what do you find holding the soil particles to the young roots? 4. Under the scope what do these small soil particles appear to be?

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*Study Number Twenty.

Osmosis.

Apparatus—Glass tube.

Materials—Paraffine or candle drip; egg.

Procedure—Chip away the shell of the large end of an egg, taking care not to break the membrane underneath. Expose an area of the membrane thus the size of a dime. Break a small hole through the pointed end of the egg and over this hole seal a short glass tube in an upright position by means of melted paraffine. Now place the egg in the top of a wide mouthed bottle in such a position that the exposed membrane is beneath the surface of the water. (Fig. No. 28.) Leave the egg thus for several hours. Illustrate by drawing.

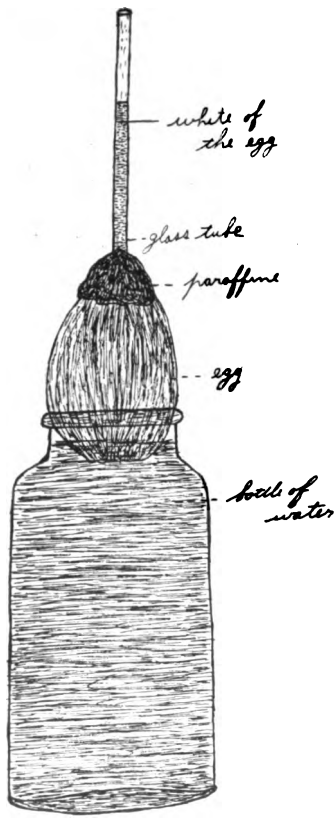

Fig. No. 28. Illustrating study number twenty.

Questions—1. What takes place in the experiment above? 2. Where is osmosis taking place in the plant body? 3. To what height does the white of the egg rise in the glass tube in twenty-four hours? Get the necessary data from the teacher and compute the pressure needed to hold the white of the egg column to height found. What sort of pressure would you call this?

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*Study Number Twenty-one.

Osmosis.

Apparatus—Knife, 2 shallow dishes or pie tins.

Materials—Potato, strong salt solution, water.

Procedure—From the potato cut medium thin slices and put three slices in a dish of pure water and three in a dish of salt water. Set them aside for thirty minutes or an hour and then examine them.

Questions—1. What conditions do you find at the end of the half hour? 2. How do you account for the differences? Explain the process of osmosis. 3. Under natural field conditions, where do you find the strongest solution, in the soil or in the young plant roots? 4. Why will young plants not grow in a strongly alkalied soil?

Study Number Twenty-two.

Illustrating Root Pressure.

Apparatus—Glass tubes, ring-stand, rule, rubber tubing.

Materials—Potted geranium.

Procedure—Take the potted geranium and cut the stem off three inches above the soil. On this put a 12″ glass tube with a bore the diameter of the plant stem and hold it in place thus with a 2″ piece of rubber tubing. Clamp the tube in a vertical position with the ring-stand. Put the plant thus treated where it will have good growing conditions and keep the roots well supplied with water. (Fig. No. 29.)

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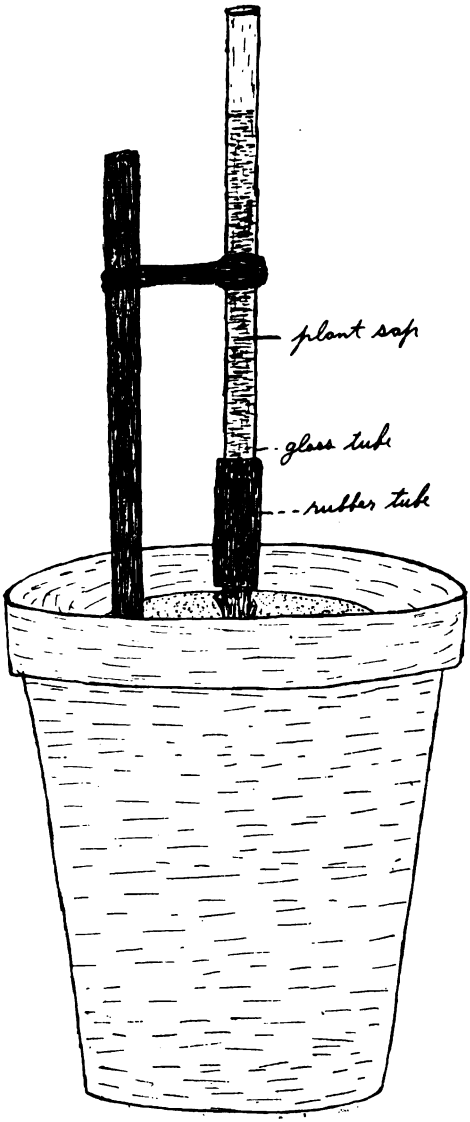

Fig. No. 29. Illustrating study number twenty-two.

Questions—1. What took place in the apparatus arranged above? 2. What was the cause of this? 3. How high was the column of liquid in the glass tube? (Problem—Get from your instructor the necessary data and compute approximately the force required to hold up the column of liquid.) 4. Where was this force exerted and by what?

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*Study Number Twenty-three.

The Region of Root Growth.

Apparatus—Pen and ink or indelible pencil, ruler.

Materials—Young plant with vigorous root system that has been grown between damp blotters.

Procedure—Lay the ruler along the side of a root two or three inches long and with a pen mark off eighth inch spaces along the root. (Fig. No. 30.) Treat several roots thus. Keep these plants between moist blotters and observe the roots from day to day. Illustrate by drawing.

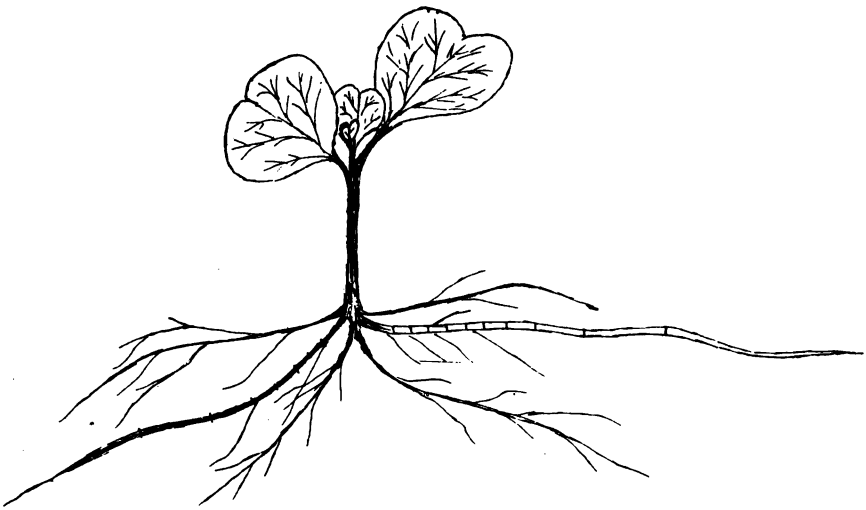

Fig. No. 30. Illustrating study number twenty-three.

Questions—1. Are all of the marks on the roots getting further apart? 2. Where do you find a portion of the root that is not marked? 3. What advantage does the increase in length at the place the increase takes place give the root in securing food?

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*Study Number Twenty-four.

The Function of the Soil Water.

Apparatus—Two tumblers, 2 rubber bands, 2 squares of mosquito netting 6" x 6".

Materials—Well water, distilled water or rain water and a half dozen grains of wheat.

Procedure—Take the two tumblers and cap each with the mosquito netting in such a manner that it droops down into the tumbler about an inch and one-half in the middle. Hold the netting in this position by placing a rubber band around the top of the glass. Fill one glass with well water and one with distilled water or rain water. Place six seeds upon the netting in each tumbler. See that they are suspended in the water. (Fig. No. 31.) Add water each day to replace that which evaporates. Watch results.

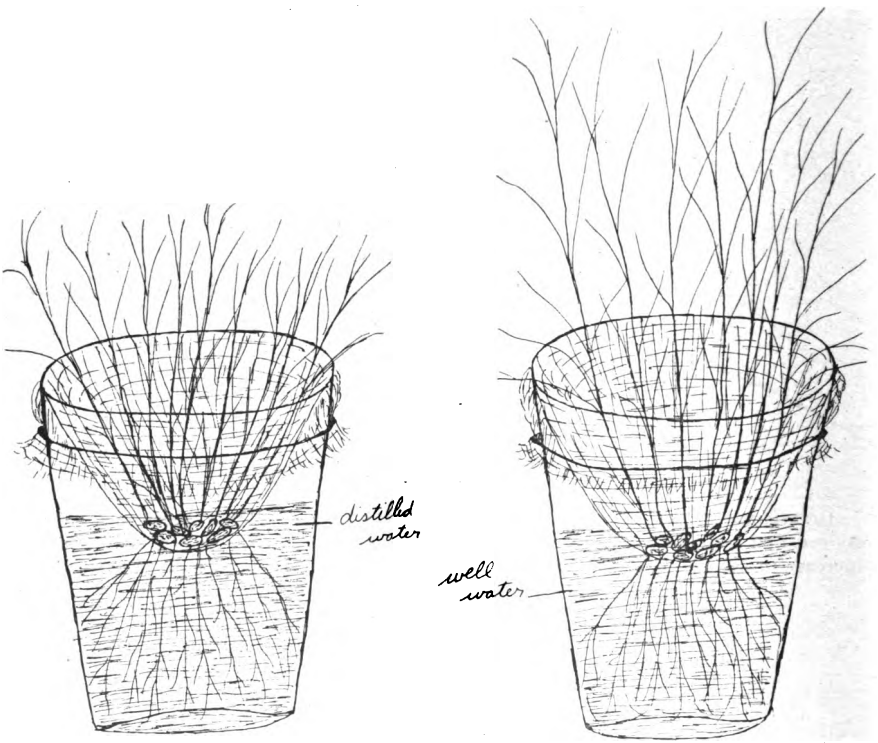

Fig. No. 31. Illustrating study number twenty-four.

Questions—1. How do the seeds in each glass compare in time of germination? How do you account for this? 2. How do the young plants compare in growth after germination? How do you account for this? 3. Of what use is the food stored in the seed? 4. What is the function of the soil water to the plant?

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*Study Number Twenty-five.

The Plant Takes Food From the Soil.

Apparatus—Two pint tin cans, 2 iron crucibles or fire shovel, Bunsen burner or stove.

Materials—Distilled water or rain water, wheat seed.

Procedure—Collect two pints of clean sand. Heat it in an iron crucible until all organic matter is burned out. Fill one pint can with the burned out sand and one with natural sand. The cans should have holes in the bottom for drainage. In each can plant a half dozen wheat seeds. Water both cans with distilled water or rain water and put them in a warm place. From this point on, water can No. 1 with distilled water only and can No. 2 with well water. Continue for a month and watch results as the plants grow. (Fig. No. 32.)

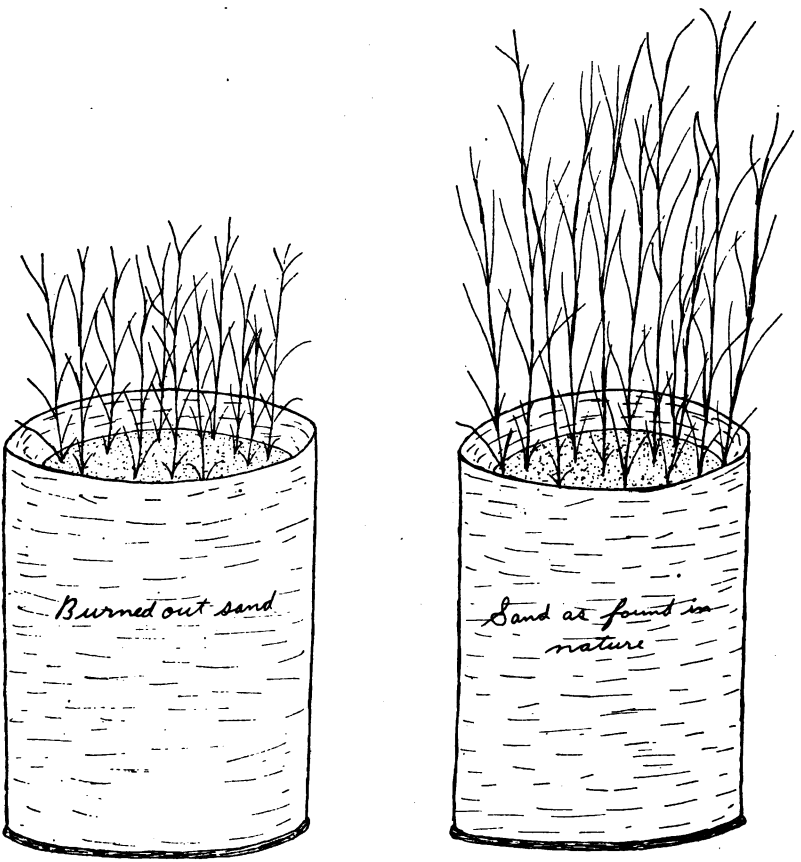

Fig. No. 32. Illustrating study number twenty-five.

Questions—1. What conditions do you find in the two cans? 2. To what is the difference due? 3. What does a natural soil contain? 4. What does all soil water contain?

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Study Number Twenty-six.

The Acid Action of Roots.

Apparatus—Glass funnel, ring-stand and funnel support.

Materials—Blue litmus paper, sand, distilled water or rain water and a few grains of wheat.

Procedure—Place the funnel in an upright position with the ring-stand and funnel support. In the funnel place a piece of litmus paper (blue) folded to fit. Fill the funnel with sand washed perfectly clean with distilled water or rain water. Put a few wheat grains next to the litmus paper and keep moist with distilled water or rain water. (Fig. No. 33.) Note what takes place as the seeds grow roots.

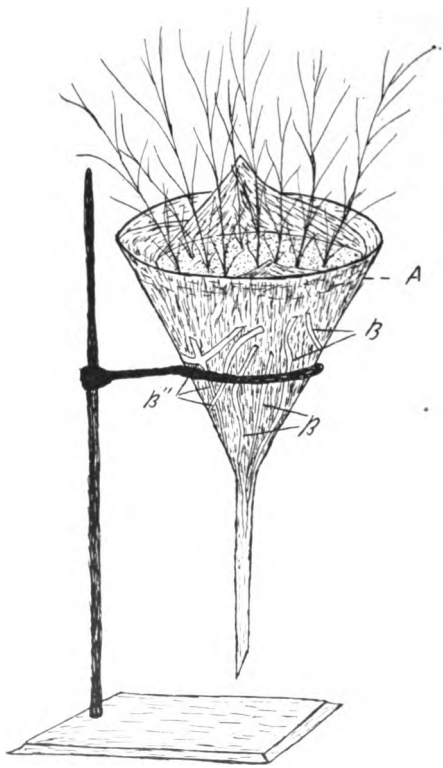

Fig. No. 33. Illustrating study number twenty-six.
A—Glass funnel lined with blue litmus paper.
B, B' & B''—Blue litmus changed to red when the growing roots touched it.

Questions—1. Why was the distilled water or rain water used above? 2. How does the root aid in dissolving solid materials in the soil?

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*Study Number Twenty-seven.

Legume Plants.

Apparatus—Spades, notebook.

Materials—To be found.

Procedure—Take a short field trip for the purpose of collecting specimens of the different legume plants growing in the neighborhood. In securing root samples of the plants dig down deep, getting a goodly number of the smaller roots.

Note the growth characteristics of the root systems and of the foliage of the different legumes as they are being dug.

Find the nodules, containing the nitrogen gathering bacteria, upon the roots of the various legumes. Compare them as to size and position. Make a drawing of each type of root with nodules attached.

Questions—1. Where do you find the nodules? 2. In what indirect way do they aid plant growth? 3. What makes the legume crops the most valuable green manure crops? 4. Why is land much improved after five or six years of growing alfalfa?

Study Number Twenty-eight.

The Root Hold of a Plant.

Apparatus—String, spring balance.

Materials—Vigorous growing young plant in its native soil.

Procedure—Go into the field and find a vigorous young plant. Loop the string firmly around the plant as close to the ground as possible. Hook the spring balance into the opposite end of the loop and slowly pull straight up on the plant. Watch the balance carefully as the pointer runs down and take the reading the instant the plant pulls from the ground.

Questions—1. What force was necessary to pull the plant? 2. What part of this force was due to the weight of the plant? 3. How do you account for the fact that so much force had to be used?

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*Study Number Twenty-nine.

The Root Seeks the Earth and Darkness.

Apparatus—Small box.

Materials—Seeds of the bean, young plant, clean sand.

Procedure—Fill the box to within an inch of the top with clean sand. Moisten the sand thoroughly. Plant four beans half the thickness of the seed the hilum down in the sand, four with the hilum turned to the right, four with the hilum turned to the left and four with the hilum facing up. Cover the seeds with moist blotting paper and place the box in a warm part of the room. Keep sand and blotting paper moist. (Fig. No. 34.) Observe from day to day.

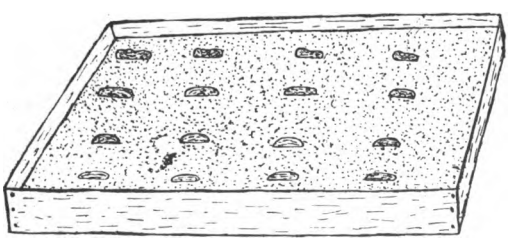

Fig. No. 34. Illustrating study number twenty-nine.

Questions—1. Where does the young root break through the seed coat? 2. Does the position of the seed affect the general direction of root growth? The direction of stem growth? 3. How do you account for the conditions found in the above study?

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*Study Number Thirty.

The Root Seeks Moisture and Plant Food.

Apparatus—Small box, wire fly screen.

Materials—Sand, and wheat seed.

Procedure—Knock the bottom out of the box and in its place tack wire fly screen. Fill the box about a third full of moist sand. Plant a dozen wheat seeds in the box and water thoroughly. Place the box in a warm place, propping one end up two or three inches higher than the other. (Fig. No. 35.) Water as needed. Watch root growth.

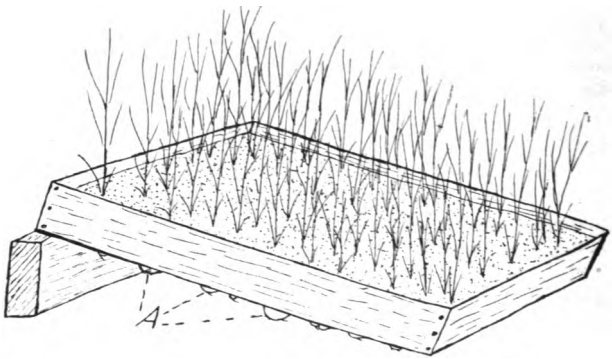

Fig. No. 35. Illustrating study number thirty.
A—Roots growing through screen bottom and then turning back.

Questions—1. Do the roots grow down through the soil? 2. Do they continue to grow on down? 3. Account for the manner of growth that took place.

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*Study Number Thirty-one.

The Stem and Leaves Seek Air and Light.

Apparatus—Three small boxes.

Materials—Bean seeds, corn seeds.

Procedure—In each of two boxes of clean sand plant a half dozen beans and a half dozen grains of corn. Moisten the sand thoroughly and upon one of the boxes invert a box of the same size and prop it up at one end with an eighth inch block. Put this covered box and the uncovered one side by side in a warm place by a window. Note the plant growth in each from day to day. (Fig. No. 36.)

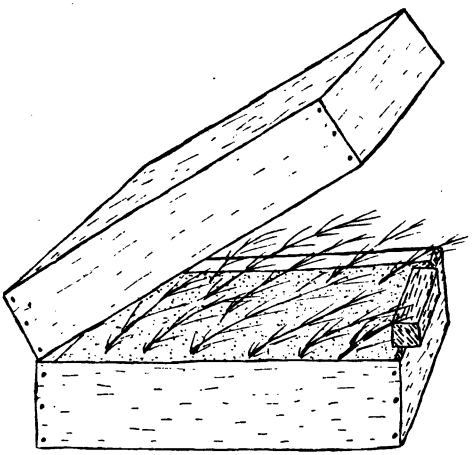

Fig. No. 36. Illustrating study number thirty-one.

Questions—1. Does the seed need light for germination? 2. What sort of growth did the plants in the covered box make? Explain. 3. How long would a plant kept from the light continue to grow?

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*Study Number Thirty-two.

The Plant Upside Down.

Apparatus—Flower pot, or tin can.

Materials—Young growing plant.

Procedure—Plant a young plant in a flower pot by putting the stem and leaves down through the drain hole in the bottom of the pot. Place the pot in a rack with the stem and leaves pointing down and put it where it will receive the light. (Fig. No. 37.) Keep the plant watered and note the growth each day for two weeks. Make four drawings representing the stages of growth in the stem. After two weeks

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wash the earth from around the roots and note their direction of growth. Illustrate by drawings.

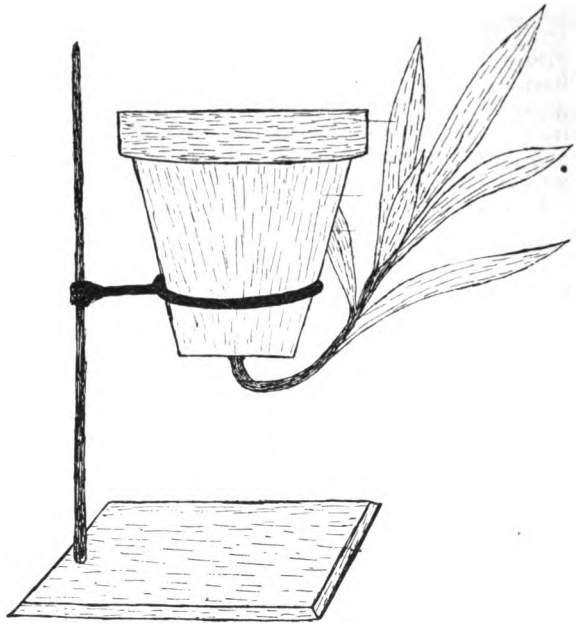

Fig. No. 37. Illustrating study number thirty-two.

Questions—1. What is the direction of stem growth? Of root growth? 2. From past studies explain the conditions you find here.

Study Number Thirty-three.

The Leaf.

Apparatus—Bunsen burner, half dozen test tubes, mortar, water glass.

Materials—Iodine crystals, grain alcohol, cooking starch, a few grains of corn, a green leaf that has been recently taken from the sunlight, wood alcohol.

Procedure—(*a*) Dissolve several of the iodine crystals in a test tube of grain alcohol. Heat to the boiling point a few grains of starch in a test tube of water. Add a few drops of iodine to the starch water. Note results.

(*b*) Grind up a few grains of corn in the mortar and treat as you treated the starch above. Note results.

(*c*) Partly fill a test tube with wood alcohol. In the alcohol submerge a green leaf. Set the test tube aside and leave it until the green color of the leaf disappears. Grind the leaf to pulp and place it in a test tube of water, heat to the boiling point and test the water and leaf with iodine. Note results.

(*d*) Take a leaf from a plant that has been in the dark for several days. Treat as you treated the leaf above. Note results.

Questions—1. What took place when the iodine solution was added to water containing starch? 2. What did the iodine test show present in the corn grain? 3. What did the iodine test show for the leaf soaked in alcohol in (*c*) and (*d*)? 4. What is the function of this green coloring matter that the alcohol dissolved from the leaf? 5. What is this coloring matter called? 6. When is it performing its function?

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*Study Number Thirty-four.

The Leaf—Continued.

Apparatus—Glass funnel, water glass, test tube, two quart jars, two pie tins.

Materials—Some green growing water plant, two candles.

Procedure—(*a*) Put the water plant in a tumbler of water. Over the plant place a funnel. Over the upper end of the funnel invert a test tube completely filled with water. Place this apparatus in the sunlight. (Fig. No. 38.) Note bubbles rising

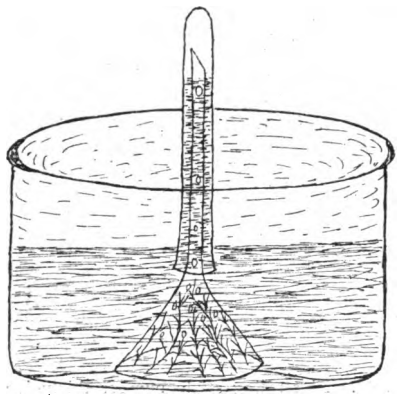

Fig. No. 38. Illustrating study number thirty-four (section A).

from the green plant. When the gas fills the test tube, test it with a glowing splinter. Note results.

(*b*) Invert two quart jars over a burning candle floating upon a flat cork in a pie tin of water. When the candles have burned out slip a leaf beneath one jar, removing candle. (Fig. No. 39.) Do not lift the jar above the level of the water

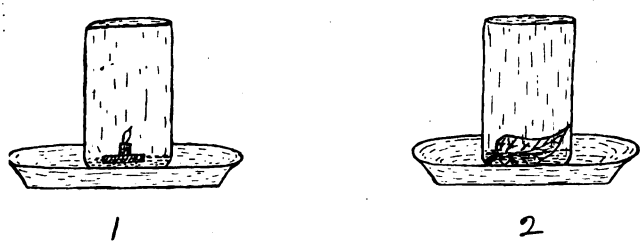

Fig. No. 39. Illustrating study number thirty-four (section b).

in doing this. Set the apparatus aside in a light place and leave for twenty-four hours. Raise the jars carefully and slip a lighted candle under each. Note results.

Questions—1. What was the gas in the test tube? 2. Where does the water plant get its oxygen and carbon dioxide for growth and life processes? 3. When the candle ceases burning under the inverted glass jar what does the air lack? 4. What did you find, after twenty-four hours, in the glass inverted over the leaf? Tell how these conditions came about.

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*Study Number Thirty-five.

The Leaf—Continued.

Apparatus—Test tubes, Bunsen burner.

Materials—Green leaves, cotton, paraffine.

Procedure—(*a*) Dip the broken end of the stem of a green leaf into melted paraffine or candle drip. Roll the leaf and place it in a test tube.

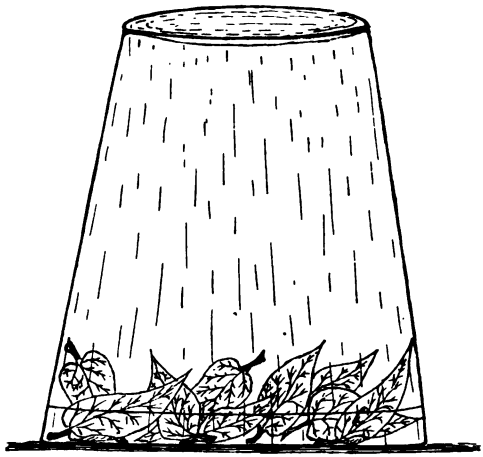

Fig. No. 40. Illustrating study number thirty-five (Section A, 2d part).

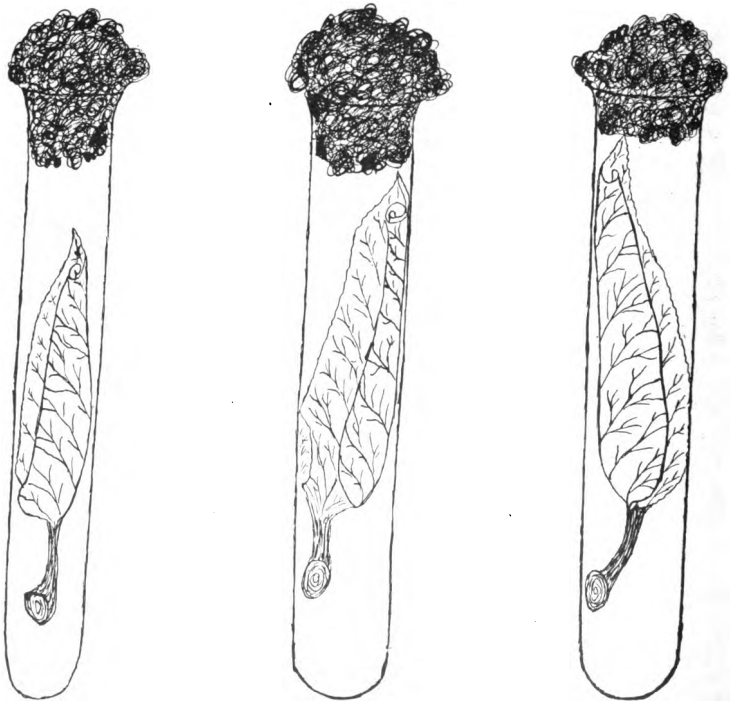

Fig. No. 41. Illustrating study number thirty-five. Section B.

Plug the test tube with cotton and lay it in the sunlight. Or dip the stem end of a half dozen leaves in candle drip and place them under an inverted glass in the sun-

(*b*) Take three leaves and dip the stem of each in melted paraffine. Paint the upper side of one leaf with vaseline and the under side of the other; leave the third leaf as it is. Roll and place each in a separate test tube. Plug the test tubes with cotton. (Fig. No. 41.) Put each in the sunlight. Note results.

Questions—1. In each case what took place in the test tube? 2. Which leaf gave off the most moisture? Which the least? Explain. 3. What is the process of giving off water vapor called? 4. Why is this process necessary?

General Questions—1. What different things, and under what conditions for each, does the growing leaf give off? 2. What does the growing leaf use? 3. What becomes of the food material that the leaf manufactures? 4. What are the two sources of plant food? 5. From which source is the most obtained? 6. Why is it that the plant food supply in the air is not exhausted?

Study Number Thirty-six.

The Plant Gets Food From the Air.

Apparatus—Test tube, Bunsen burner.

Materials—Small branch of a tree; nitric, hydrochloric and sulphuric acid.

Procedure—Secure a branch of a tree a half inch in diameter. Cut off a few short pieces and place them in a test tube. Heat the test tube until all water and smoke is driven off. When heating do not allow the wood to blaze. Take the material that is left after smoke ceases to come off and attempt to dissolve it in cold water, in hot water. Try to dissolve it in weak acids.

Questions—1. What was the color of the material left in the test tube? What was it? 2. Could you dissolve this in water or in weak acid solutions? 3. Could the soil water dissolve this material? 4. How did this material get into the plant structure?

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*Study Number Thirty-seven.

To Show Transpiration.

Apparatus—One wide mouthed bottle, cork to fit bottle, knife, scales and weights.

Materials—Young plant, as cabbage or some weed; candle or paraffine.

Procedure—Secure some single stemmed young growing plant, as a cabbage or some young weed. Take precaution to get as much of the young root system as possible.

Place the roots of this plant in a wide mouthed airtight bottle three-fourths full of water, either well water or that secured from a stream or irrigation ditch. To do this take the cork and bore a hole through the middle large enough to accommodate the stem of the plant and then split the cork from one side to this hole. (Fig. No. 42.) Through this split place the cork around the plant and with it cork the bottle tightly in such a manner that the roots are well in the water. To make the bottle airtight fill in the split and the hole around the plant with melted paraffine or the drip from a burning candle. Hold the burning candle well above the plant and apply the drip slowly, drop by drop. Turn the bottle upside-down to see if any water escapes; if so apply candle drip at the points of escape until you are sure that the bottle is airtight.

Take the weight of the bottle and the next morning place it in the sunlight. Take its weight every day for two weeks.

Questions—1. Does the bottle decrease in weight? 2. What does this decrease show? 3. How did the water leave the bottle? 4. What weight of water has the plant used? 5. Has the plant made any growth? If so, where did it get material for growth? 6. Under natural conditions, of what use is the water obtained from the soil to the plant?

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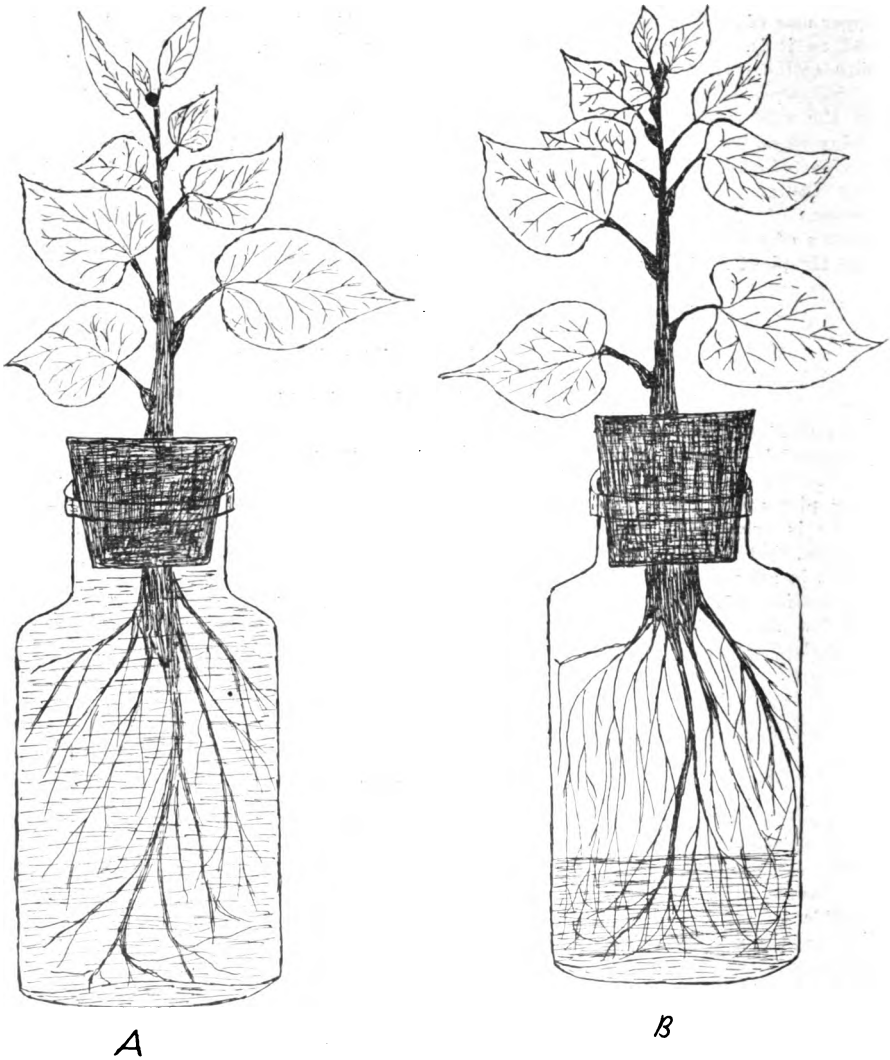

Fig. No. 42. Illustrating study number thirty-seven.
A—Bottle filled with water and made air tight.
B—Same bottle two weeks later.

Study Number Thirty-eight.

Structure of the Leaf.

Apparatus—Microscope, dissecting tools.

Materials—Green leaves of some young plant.

Procedure—Make a cross section slide of the leaf and examine it under the microscope. Draw the slide as seen, labeling the chlorophyll bodies, starch grains, epidermal cells, pyramidal cells, intercelluar tissue, and stomato.

Questions—1. What are the functions of each of the following: stomato, epidermal cells, pyramidal cells, intercellular spaces, starch grains, chlorophyll bodies nd intercellular tissue?

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*Study Number Thirty-nine.

The Buds.

Apparatus—Knife, lens, water glass, mosquito netting, rubber band.

Materials—Dormant branches of several types of trees, branches of several types of trees in full leaf, a potato, some wheat seed, some geranium branches, roots of the Shasta daisy or a sweet potato.

Procedure—(*a*) Take the dormant branches at hand. Make a drawing of each, indicating lateral buds, terminal buds and accessory buds, and little clusters of partial rings at intervals along the branches.

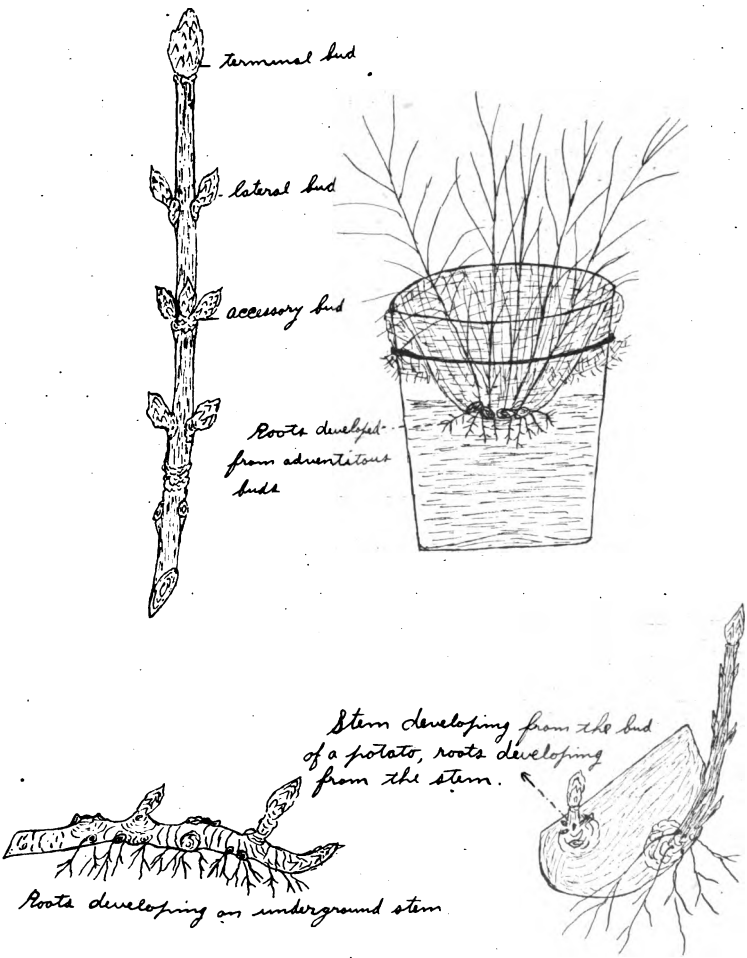

Fig. No. 43. Illustrating study number thirty-nine.

Questions—1. How old is each branch? 2. How can you tell its age? 3. What caused the little clusters of partial rings? 4. What then does each cluster of rings represent?

(*b*) Take the branches bearing leaves. Look for axillary buds. Indicate by drawing axillary and terminal buds. Note the difference in the bud development of the current year's growth and the past year's growth. (Fig. No. 43.)

Questions—1. How do you account for the differences in bud development found above? 2. What are some of the buds upon the older wood developing? 3. What

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has become of those missing from the older wood? 4. Where do you find the buds upon the current year's growth?

(*c*) Secure branches of some of the common fruit trees, if in bloom, and note the position of leaf buds and fruit buds. Indicate them by a drawing.

Questions—1. Where do you find most of the fruit buds? Most of the leaf buds?

(*d*) Take the potato and find and examine the buds. Cut the potato in two pieces and plant them in damp sand. Watch the development of stem, leaves and roots. Illustrate by drawings.

Questions—1. From what did the stem develop? The leaves? 2. From what did the roots develop? 3. What sort of buds formed the roots?

(*e*) Make and plant some geranium cuttings. Watch them for the development of roots, stems and leaves. Illustrate by drawings.

Questions—1. From what part of the geranium do the stem and the leaves come? The roots? 2. What sort of buds developed the roots?

(*f*) Plant, in damp sand, a portion of a Shasta daisy root or a sweet potato. Note the development of roots, stem and leaves. Illustrate by drawings.

Questions—1. What sort of buds developed the stem and leaves? 2. What sort of buds developed the roots?

(*g*) Place some grains of wheat on a mosquito netting suspended in a glass of water. After the wheat has made some growth cut the roots back and note the development of the new roots.

Questions—1. From what part of the plant did the original roots develop? 2. From what part did the second growth of roots develop? 3. From what sort of buds did the second growth develop?

(*h*) Secure, examine, and illustrate by drawing covered buds and naked buds.

General Questions—1. What do you understand by bud propagation? 2. Name several methods of bud propagation. 3. Why is bud propagation used? 4. For successful budding of fruit trees what type of bud must be used? 5. Why do not trees from seeds, as from buds, always grow the same type of fruit as the parent tree?

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*Study Number Forty.

The Upward Passage of the Soil Solution in the Plant.

Apparatus—Eight ounce wide mouth bottle.

Materials—Red ink, young plant grown in the dark.

Procedure—Fill the bottle three-fourths full of water. Color the water with a half dozen drops of red ink. Carefully remove the young plant from the soil, getting as many roots as possible. Gently shake the plant to remove most of the adhering soil and place the roots in the red ink solution. Set the bottle in a warm dark place and after twenty-four hours examine the plant.

Questions—1. What took place in the plant? 2. By what processes does the plant take water to all of its parts? 3. Any plant food in the soil to be available for plant use must possess what property?

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*Study Number Forty-one.

The Stem.

Apparatus—Jelly glass, knife.

Materials—Stems of calla lily and sweet pea with flowers attached, stalk of corn, branch of a hardwood tree, bottle of red ink.

Procedure—(*a*) Color a glass of water with a few drops of red ink. In the glass place a stem of the calla lily and the sweet pea. Set the glass aside and several

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hours later examine the flowers. Cut the stem of the lily lengthwise and trace out the red lines that you find. Draw a diagram of the stem and flower showing the red lines as you see them. (Fig. No. 44.)

(*b*) Make a cross section and a longitudinal section of a cornstalk and draw each. Do the same with a hardwood stem. Point out and label the types of tissue composing each stem.

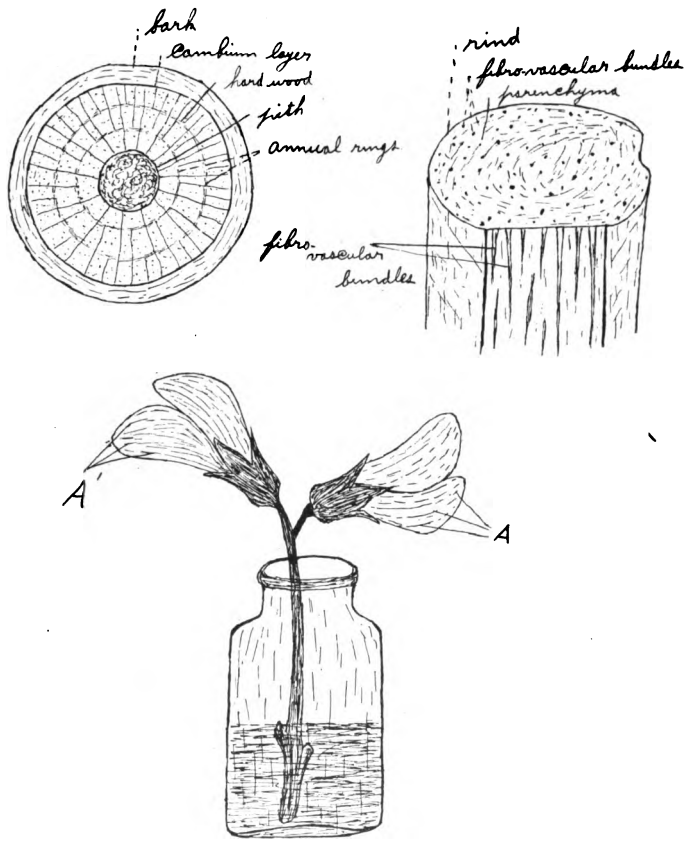

Fig. No. 44. Illustrating study number forty-one.
A and A'—Red ink in the fibero-vascular bundles in the petals of a white sweet pea.

(*c*) Collect from the campus and garden a number of stems and group them into classes represented by the cornstalk and the hardwood stem.

(*d*) Draw a cross section of a hardwood tree several years old and label all parts.

Questions—1. What are the functions of the stem? 2. By what processes did the colored water get from the glass to the flower? 3. Through what did this water pass? 4. How can you tell the age of a tree? 5. How are the rings developed? 6. What is the function of each stem part here mentioned: bark and rind, cambium tissue, sieve tubes, medullary rays, parenchyma tissue, fibrovascular bundles and hardwood tissue?

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Study Number Forty-two.

Some Stem Types.

Materials—To be secured.

Procedure—Take a field trip and find and make drawings of the following types of stem: deliquescent, excurrent, trailing, creeping, decumbent and two types of climbing stems.

Questions—1. What are the functions of the stem? 2. What do you understand by a modification or reduction of the stem? Have these characteristics benefited the plant? 3. In what way are stems and stem parts used in plant propagation? What is the advantage of this sort of propagation over seed propagation?

Exercise—Fill in the following table of stem products and tell which of these you consider the most valuable to mankind, and why:

Stem Products	The Source of Supply
Food (three)	
Linen	
Lumber (six)	
Sugar sap	
Cork	
Fuel (six)	
Hemp	
Tannin	
Turpentine	

*Study Number Forty-three.

The Needs of the Growing Plant.

Apparatus—Flower pots.

Materials—Box planted to young plants.

Procedure—(*a*) Place a young potted plant where it will get plenty of sunlight and withhold the water from it until it is quite badly wilted. Water thoroughly and note results.

(*b*) Submerge entirely the pot in which a young plant is growing and keep it thus for two weeks. Note the condition of the plant from day to day.

(*c*) Submerge a flower pot, in which is growing a young plant, up to the rim in a pan of warm water. Place a second flower pot, as above directed, in a pan of melting ice and water. In a short time contrast the rigidity of stem and leaves of the two plants.

(*d*) Put a potted plant in a cool place, put one where it is dark but warm, put one where it is light and warm. In each keep the soil moist. Observe daily and note growth and changes of each.

(*e*) Paint the leaves and stems of a young plant thoroughly with melted vaseline. Give the plant ideal growing conditions.

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Questions—1. What happened to the wilted plant studied in section (*a*) when watered? 2. What gives a green plant its rigidity? 3. What happened to the plant whose roots were submerged in water? 4. What was the cause of this? 5. What brought about the conditions observed in the two plants contrasted in the study of section (*c*)? Those studied in section (*d*)? That studied in section (*e*)? 6. What are good conditions for a growing plant?

Study Number Forty-four.

Water, Dry Matter and Ash in Plants.

Apparatus—Scales, weights, test tubes, crucibles.

Materials—A green growing plant, dry hay.

Procedure—Weigh two thoroughly dried test tubes. In one place a young green plant and weigh again. In the other place some dry hay and weigh again. Place these in the drying oven and heat for twenty-four hours at a temperature of 98° C. Reweigh each tube. The above treatment has driven off the water.

Burn the plants by heating very hot in a previously weighed porcelain crucible until only a light gray ash remains. Reweigh. The difference between the weight of the ash and the dried plants is the weight of the dry matter.

Record as follows:

Weight of test tube_____
Weight of test tube and plant_____
Weight of plant_____
Weight of dried plant_____
Weight of ash_____
Per cent of water_____
Per cent of dry matter_____
Per cent of ash_____

Questions—1. To what uses is the water put in the plant body? 2. What composes the ash of the plant? 3. How and where did the plant get the material composing the ash? 4. What was the source of most of the material composing the dry matter? 5. What part of the plant body is of most food value to the animal, the water, dry matter or ash? 6. Were the green plant alfalfa, how many tons would it take to make a ton of dry hay?

NOTE.—Turn back to Study Number One and complete the work called for in the last part of that study.

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*Study Number Forty-five.

Green Cuttings.

Apparatus—Sharp knife.

Materials—Geranium branches, carnation, begonia, etc.

Proccdure—Cut off about three to four inches of the ends of the branches. This tip should possess five or six leaves. Cut away all but the upper two leaves. Cut

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these back to about one-fourth of the original surface. The remainder of the branch can be treated similarly and the other branches can be made into cuttings in the same manner. (Fig. No. 45.)

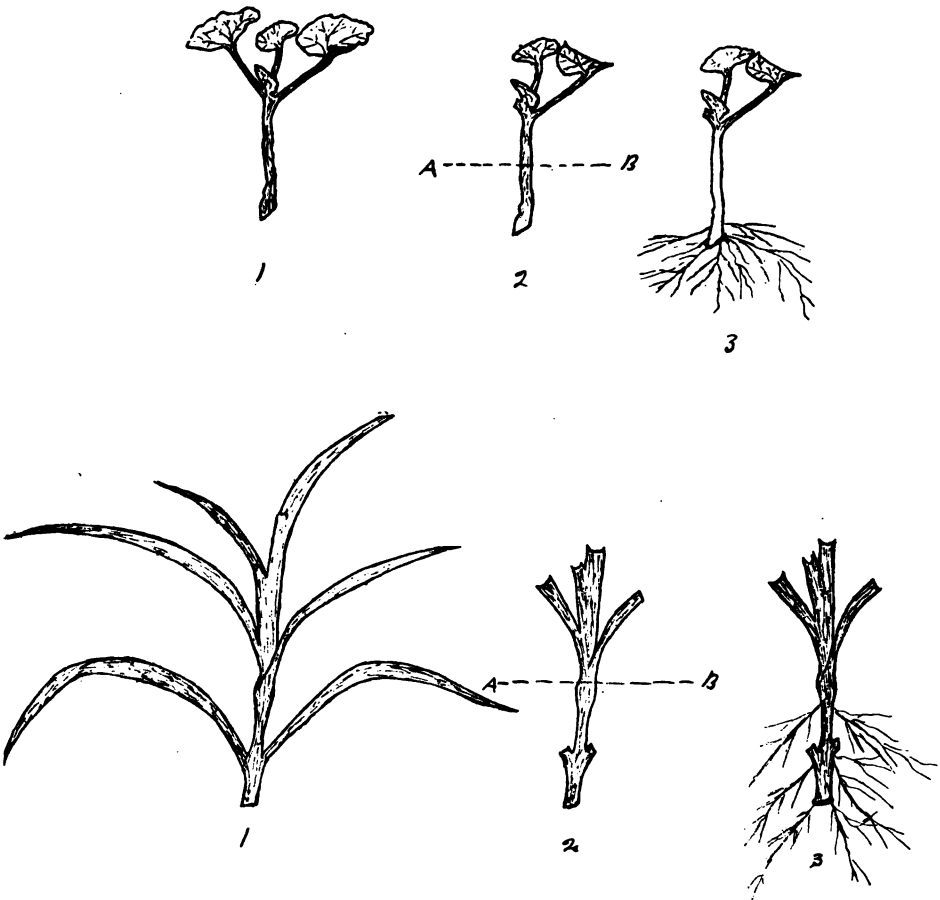

Fig. No. 45. Illustrating study number forty-five.
1—Sprays of the geranium and carnation taken for cuttings.
2—Cuttings ready for setting in sand, line A—B shows depth of planting.
3—Cuttings well rooted.

When the cuttings are made, plant them in the sand with the leaves about an inch above the surface.

Questions—1. What are the advantages of making cuttings to grow new plants over the use of seeds? 2. Can cuttings be made of all kinds of plants? Why not?

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*Study Number Forty-six.

To Make Hardwood Cuttings.

Apparatus—Knife, string.

Materials—Dormant branches of the grape, currant, raspberry, poplar, rose, willow, etc.

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Procedure—Make the cuttings of each by cutting the branches into pieces about eight inches long, having at least three buds attached. Use a pair of pruning shears or a sharp knife and make a smooth, clean cut diagonally across the stem in a position that the bud both at the top and the bottom of the cutting is an inch from the cut surface. (Fig. No. 46.) Heal the cuttings in damp sand until early spring.

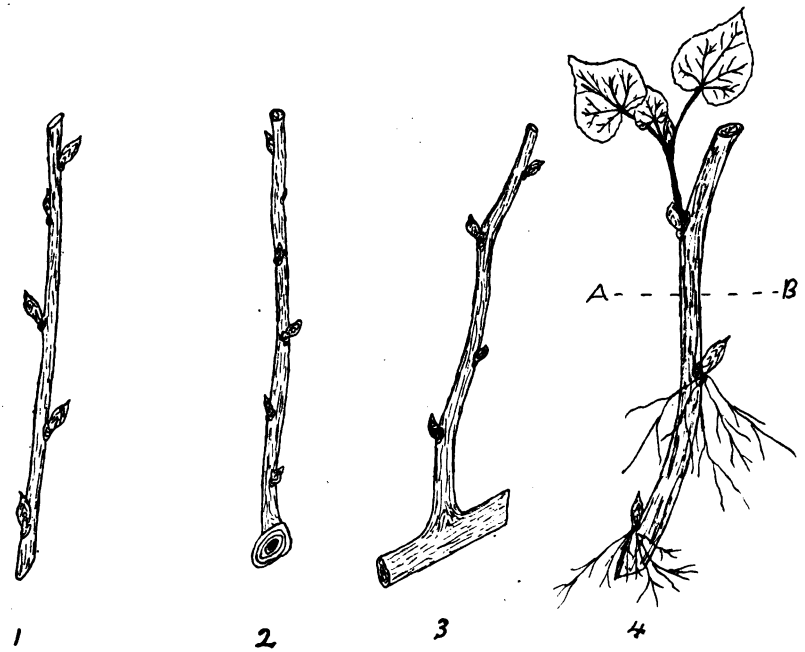

Fig. No. 46. Illustrating study number forty-six. 1—Ordinary cutting. 2—Heel Cutting. 3—Mallet cutting. 4—Grape cutting well rooted. Line A-B shows depth of planting.

Questions—1. Why make the cut an inch from the bud in making cuttings? 2. Why do hardwood cuttings do best when healed in damp sand instead of being planted out immediately after made? 3. Why is it often more profitable to propagate by cuttings than by seed? 4. Why is it best to make hardwood cuttings in the late fall or early winter?

*Study Number Forty-seven.

Struggle for Existence.

Materials—Ear of corn, spike of wheat, or a weed (cocklebur) growing many seeds.

Procedure—Count all of the seeds on the grain plant chosen and all of the seeds on the cocklebur. Begin with one seed for each plant and allow that that seed produce the number of seeds that you have counted for each plant above. Now suppose that all of these seeds grew the next year and each seed produced as many seeds as did the first seeds, and so on for five years.

Questions—1. How many plants of each type will be growing the fifth year? 2. Why do not conditions supposed above come to pass? 3. If the cocklebur plant produced by the first seed occupied to the exclusion of other plants a plot of ground 2′ 8″ by 3′ 4″ square and all of the succeeding plants occupied the same area, how many acres of ground would the offspring from the one original seed have occupied in five years?

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*Study Number Forty-eight.

Struggle for Existence.

Apparatus—Foot rule, knife, notebook.

Materials—To be found.

Procedure—Take the class to a weed patch or some place where vegetation is growing thickly under natural conditions. Have each student measure off an area two feet square. Count the approximate number of plants growing on this area and group them as vigorous, medium vigorous, weak, very weak.

Find a fruit tree, an apple, plum, peach or almond. Count the number of buds and twigs or blossoms and twigs on a limb of the tree. Note the growing conditions for all and class them as good, fair or poor.

Questions—1. How many plants did you find on the area of two feet square? 2. What per cent of them give indications of maturing and developing vigorous seed? 3. What per cent of buds or blossoms studied will produce well developed fruit or vigorous twigs? 4. What per cent of the twigs will develop into branches? 5. Which plants and plant parts survive under natural conditions? 6. What would happen to our present cultivated plants if left to natural conditions?

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*Study Number Forty-nine.

Variation in Plants.

Apparatus—Scales and weights, foot rule.

Materials—Branches and leaves of some tree, several stalks of wheat.

Procedure—Take a branch of a tree and attempt to find two leaves that are alike. Select the two leaves that seem the most alike and compare them in minute detail and note differences. This can best be done by making a list of the leaf characteristics and noting how they differ in these characteristics.

Select two very similar stalks of wheat. Compare them and note differences as follows: Number of leaves, number of spikelets, length of spike, length of stalks, diameter of stalks, length of corresponding internodes, shape of leaves, number of grains of wheat in each spike, total weight of grain in each spike, total weight of each stalk and leaves, total weight of each plant, stalk, leaves, grain and all.

Questions—1. To what conclusion do the above studies bring you? 2. What opportunity does the condition you found in plants give the grower of plants for plant improvement? 3. Were all plants identical would it be possible to improve them? Explain.

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*Study Number Fifty.

Dispersal of Seeds.

Procedure—Take a short field trip. Collect plants bearing seeds and note under which class it would come for seed dispersal. Dispersal by wind, water, animals or plant mechanisms.

Make a drawing of several types of plants and of seeds in each class, and give a short description of the process of seed dispersal.

Questions—1. What part does the method of seed distribution play in the struggle for existence? 2. In a given length of time, which would scatter the farthest, trees like the oak or the poplar?

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*Study Number Fifty-one.

Seed Germination Test.

Apparatus—Six small plates or pie tins; blotting paper.

Materials—Six seed samples, water.

Procedure—Take a sample of several different kinds of seeds, as clover, alfalfa, wheat, cabbage, radish, etc., and from each sample count out a hundred seeds. This done, get a plate or a pie pan and cover the bottom of it with blotting paper. Thoroughly moisten the blotting paper and upon it sprinkle the sample of 100 seeds; over the seeds place a second sheet of blotting paper. Over this plate lay a piece of glass or an inverted pie tin and place it in a warm place. Apply water often enough to keep the blotter moist. When the seeds begin to germinate count out each day and throw away those that have germinated. Do this until you are sure that the remaining seeds will not germinate.

Record as follows:

Total number of seeds_____
Number of seeds that germinated_____
Number of seeds that did not germinate_____
Per cent of germination_____

Questions and Problems—If the alfalfa seed tested sold at $16.50 per hundredweight, what was the actual cost of the seed that germinated?

If you were sowing the alfalfa seed tested at the rate of eight pounds per acre, what per cent would the seeding fall short of growing a perfect stand of alfalfa?

If you were sowing the wheat tested above at the rate of 85 pounds per acre, what per cent would the seeding fall short of growing a perfect stand?

What could be done to bring the stand up to normal in each case given above?

---

*Study Number Fifty-two.

Seed Analysis.

Apparatus—Scales and weights, small plate, blotting paper.

Materials—Sample of dirty impure seed, water.

Procedure—Secure a sample of unclean clover seed or alfalfa seed. Weigh out one gram of the seed and then separate it into (1) pure seed, (2) broken seed, dirt, etc., (3) weed seed. Weigh again. Make a germination test of the pure seed as directed in Study Number Fifty-one.

Record results as follows:

Weight of seed sample_____
Weight of pure seed_____
Weight of weed seed, dirt, etc._____
Per cent of purity_____
Per cent of germination_____

Questions—1. If the price of the original seed was $12.50 per hundred, what was the cost of the pure seed that germinated? 2. Why would it not be wise to sow impure, dirty seed?

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*Study Number Fifty-three.

Depth of Planting Seeds.

Apparatus—Glass jar.

Materials—Seeds of corn, radish and clover, sand.

Procedure—Put a little sand in the jar and on it next to the glass place several seeds of each type mentioned above. Put in another inch of soil and then more seeds as above. Continue this until the jar is filled, and plant seed a fourth of an inch under the soil at the top. The jar should be at least six inches deep. Put the jar in a warm place and keep the sand moist. (Fig. No. 47.) Watch from day to day.

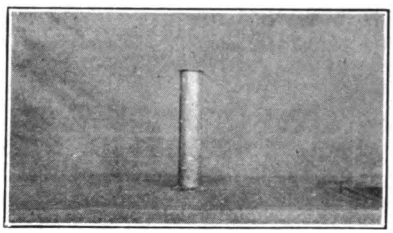

Fig. No. 47. Illustrating study number fifty-three. Corn seed planted to the depth of 2, 4, 6, 8, 10 and 12 inches.

Questions—1. What took place in the experiment above? 2. From what depth did each type of seed make the best growth? 3. Judging from the experiment, what general rule can you give for planting seeds? 4. What is the function of the stored food in the seed? 5. Why is it necessary to get the seed leaves up to the air and light?

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*Study Number Fifty-four.

Dependent Plants.

Apparatus—Dissecting tools, microscope and lens.

Materials—Mushrooms and bread mold.

Procedure—(*a*) Secure a piece of moldy bread. Examine the mold with a hand lens. Look for little upright growth capped with a tiny ball. Examine under the microscope. Draw the slide you have made. Find a little patch of mold where these little balls are black. Examine under the microscope. Draw the slide you have made.

(*b*) Gather some mushrooms. Make a drawing of a longitudinal section of the mushroom and label the different parts. Paste a mushroom upside down upon a piece of cardboard with library paste and set it aside. Look daily for the development of spores. Illustrate by drawing the development of the spore sacs. Examine some of these spores under the microscope.

Questions—Is the mushroom a plant? Where do you find mushrooms growing? What part of the mushroom bears the spores? What is the function of these spores? How are they scattered? How can you tell dependent plants? Class as parasites or saprophytes the following: mushrooms, mistletoe, dodder, bread mold, wheat rust, potato blight, grape rust, brown rot.

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*Study Number Fifty-five.

Some Injurious Dependent Plants.

Apparatus—Pie tins, pin.

Materials—Eight good apples, 8 good oranges, 4 decaying apples, 4 oranges infected with blue mold.

Procedure—Take a decayed apple and prick the decayed part with a pin and then prick a good apple with the same pin. Repeat this three or four times. Lay the good apple thus treated upon a plate. Take another apple and bruise one side of it by rapping it on the table. Lay it on a plate with the bruised side in close contact with the decaying portion of another apple. With these apples place one that is sound in every respect in close contact with the decaying portion of another apple. Put all in a warm, rather dark place. Take the oranges and treat them as you have the apple above.

Questions—1. Which apple and orange became infected the quickest? 2. Which were last in becoming infected? 3. What care should be taken in picking and packing fruit? 4. Would it pay to sort over occasionally fruit stored for home use? 5. Can apple decay and blue mold be transmitted in any other way than in the examples given above? Explain. 6. Why is it wise to wrap each fruit separately when packing them for shipping? 7. Why are oranges washed in a copper sulphate solution before packing and storing?

Study Number Fifty-six.

Conditions Favoring Bacterial Growth.

Apparatus—Three pint bottles, 3 petri dishes, Bunsen burner, drying oven, refrigerator.

Materials—Quart of milk, nutrient gelatine, sterilized cotton.

Procedure—Divide the milk equally into the three bottles. Label the bottles 1, 2, and 3. Cork No. 1 and place it in a moderately warm room. Cork No. 2 and place it in the refrigerator. Put No. 3 in a pan of water and boil for thirty minutes. Cork the bottle with sterilized cotton and put it with bottle No. 1. After forty-eight hours compare the samples of milk. Note the condition of each, the smell and taste of each.

Put some sterile nutrient gelatine in each of three petri dishes that have been heated in the drying oven at 100° C. for six hours. Label the dishes 1, 2, and 3. Put the covered dishes in a drying oven at 100° C. for one half hour a day for three days. Open dish No. 1 to the air of the room for two minutes. Cover and set in a warm, moist dark place. Examine it every day. Note any effects upon the gelatine.

Put No. 2 where it can receive the direct sunlight the greater part of the day and be left moderately cool. Note results from day to day.

Put No. 3, without the cover, in a very dry place. Note results as above.

Questions—1. What effect have dark warm places upon bacterial growth? Sunlight? Dry conditions? 2. What conditions favor bacterial growth? What retard? 3. Why does food spoil? How can food be preserved?

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FRESNO STATE NORMAL SCHOOL

BULLETIN No. 3

RURAL SANITATION

FRESNO, CALIFORNIA

JULY, 1915

CALIFORNIA
STATE PRINTING OFFICE
1915

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Rural Sanitation

BY

W. B. GIVENS,
Fresno State Normal School

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INTRODUCTION.

For the preparation of this bulletin, I am especially indebted to Dr. A. T. McCormack, secretary of the Kentucky State Board of Health. This southern state has developed the most satisfactory type of septic tank, as far as I know, for use without a water-pressure system that has yet been made in the United States. I have incorporated in this bulletin the larger part of a letter recently received from Dr. McCormack, giving so much information on the practical working of this system, that I thought it could not well be omitted.

I wish to thank Dr. G. L. Long, county health officer of Fresno County, whose cordial and enthusiastic co-operation has helped so materially to produce the plans for septic tank No. 2. I wish also to express my indebtedness to Mr. B. E. Cronkite, city engineer of Fresno, for the numerous suggestions he has given for the improvement of this particular type of septic tank.

W. B. GIVENS.

Fresno, Cal., June 15, 1915.

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RURAL SANITATION.

Country life in the United States has been and is receiving a great amount of attention. Farming now is considered a business and as such it is being considered from every point of view to make it more efficient. Some of the best scientific thought of the day is being applied to the problems of agriculture so that the financial returns may be better and more certain than heretofore. Better and more commodious farm houses are being built; attention is given to improved yards and better outbuildings. In many cases water is pumped by windmill or gas engine and piped into the house. There are also projects on foot for the improvement of social conditions in rural communities that people of all ages may have opportunities for social and recreational activities.

In the matter of rural schools, a great change has already taken place. Here in Central California, most of the new country school buildings now being erected are excellent and better suited for school purposes than were those of a few years ago. Much attetion is given to improving school grounds, both in the matter of beautifying them and in the arrangement of playgrounds. Progress is indicated along all the lines mentioned and all is being accomplished that could be expected.

General rural improvement, in one respect, however, has not kept pace with the advance in most of the other lines enumerated. This is in the matter of sanitation. Cities in order to exist at all were compelled to put in sewers and to dispose of sewage and garbage in a satisfactory way. This has been particularly true of cities during the last century or even less. This sanitary improvement has been so well done, that within this period, the death rate in all cities has been greatly decreased. It is now known that many diseases are preventable and that with proper precautions, these can be greatly decreased or almost entirely eradicated. In a number of recent investigations, it has been discovered that typhoid fever is more prevalent in country districts than in large cities, and that it is still more common in small towns and villages than in either city or country, and that this condition is due solely to the lack of proper sanitary arrangements or to impure drinking water.

In a recent bulletin on "Rural School Houses and Grounds," by Fletcher B. Dresslar, issued by the United States Bureau of Education, this question of rural sanitation is discussed at considerable length. It might be mentioned in passing that this bulletin of Professor Dresslar's

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is a most valuable one for teachers and school trustees. Professor Dresslar considers the various matters of school building construction, school yard arrangement, water supply, and sanitation in a most practical way. The whole bulletin is an epitome of results that have been worked out in various sections of the country and are here brought together for the first time. He says, "The two most important sanitary needs of country schools * * * are sanitary toilets and a safe and abundant water supply." Out of 1,232 schools reporting in a survey made by Mr. Dresslar, 631 were adjudged insanitary. In the state of Pennsylvania, it was found that 50 per cent of 3,572 schools inspected were in an insanitary condition. More than a hundred photographs were taken of both exteriors and interiors of toilets of rural schools in Connecticut, New York, Vermont, Maryland, and New Jersey, and less than five per cent of the 109 examined are sanitary, or are even passably decent. While no complete investigation has been made in California, the conditions of many country schools are too well known to need comment. Finally, in his article on sanitation, Mr. Dresslar says, "Country schools must teach the truth of sanitation and they must also set the example of building sanitary toilets and of keeping them in good condition. They must complete their teaching through demonstration of theory by fact, through co-operative activity with the people."

The need of better rural sanitation is so well recognized over the whole country that sanitary experts are bestowing a great deal of attention on this most important subject. This is notably true of some of the sttates of the Middle West and of the South. Many state boards of health, colleges of agriculture, and normal schools are working on this problem, and some very efficient types of sewage disposal have been worked out. The State of Kentucky is doing some especially noteworthy work. The health authorities in that commonwealth, some time ago, clearly recognized the fact that but little headway could be made against typhoid fever and the hookworm disease unless better sanitation in rural communities could be secured. The diseases are transmitted only through means of insanitary sewage disposal, carried for the most part by flies, or by impure drinking water. So the Kentucky Board of Health attacked the problem so successfully that a most efficient type of septic tank has been worked out with which any country school, church, or farm house may be equipped at small cost. This particular type has been in operation in many places in Kentucky for several years and has given entire satisfaction.

The sanitary conditions of most of our country schools are, to say the least, unsatisfactory. In some cases these conditions are deplorable, obnoxious in every way, and a menace to the health of the neighborhood. Typhoid fever and other diseases are carried frequently from

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such places to the food eaten by the children. This is a demonstrated fact. The germs of typhoid, hookworm, and other intestinal diseases are transmitted either in the food that people eat or the water they drink. For the worst type of open toilets, there never was any excuse. For the better type there was the excuse that people were doing the best that they knew and could afford to build. Now that sanitary experts have worked out means for overcoming one of the greatest shortcomings attendant on rural life, every country school can be made as wholesome and as healthful in this respect as can schools located in towns and cities having costly sewer systems.

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In Fresno County, and adjoining counties in Central California, there is a strong desire on the part of many people for better sanitary arrangements in country districts. For rural schools and farms that do not have water-pressure systems, nothing better has yet been devised than the Kentucky septic tank. Through the courtesy of the Kentucky State Board of Health, the general plans of this tank are here given, and this type is recommended for all places not having water-pressure with which to flush.

SEPTIC TANK No. 1.

Kentucky Non-flushing Type.

Figures 1, 2 and 3 represent the self-cleaning, fly-proof septic tank privy which, after several years of experimental work, the Kentucky State Board of Health recommends for all country and town homes, schools and other places without sewer connections. Concerning the general success of this type of septic tank, Dr. A. T. McCormack, secretary of the Kentucky State Board of Health, writes as follows:

"The first Kentucky sanitary closet built, which has been in continuous operation since, is five years old. Its effectiveness was improved for six months since which time it has been constant. The only complaints that have arisen during the operation of these closets have been where the water has not been added regularly and then a very objectionable odor is produced.

The cost of construction varies quite a great deal. The cement usually costs about $7.50. For private homes, we are now making the tank 6 x 4 x 4 in the clear and the cement for this costs $5. The sand and gravel varies so much in cost that it is difficult to estimate it. In one section of the state, contractors are building tank and house for $22 and the Louisville and Nashville Railroad Company has just let a contract for 3,000 tanks at $60. A great many have been built at schools on the co-operative plan, the older boys doing the work and the girls furnishing a picnic lunch, while it is being built, at an actual expense from $7.50 to $12, and this money has been raised from exhibits and musicals and things of that sort, which has been very satisfactory.

Where water supply for flushing is available, it is important that the tank should be of such size as to retain the contents at least twenty-four hours. We usually make a calculation as to the average number of flushings and then double it and make our tank approximately that size. The tank should be placed tolerably close to the house and there should be a half-inch vent pipe from the first chamber for the escape of gas. The outlet pipe should be just barely below the surface so water from the incoming flushing will agitate the flood. It may be found necessary to extend the tile drains some, but you can tell whether this is necessary by there being a collection of water at the ends of the pipes.

I will be very glad indeed to give you any further information on the subject and in return will appreciate your experience both in the construction and use of the tank. We have about 3,600 in operation in Kentucky now.

Very truly yours,

A. T. McCormack,
Secretary.

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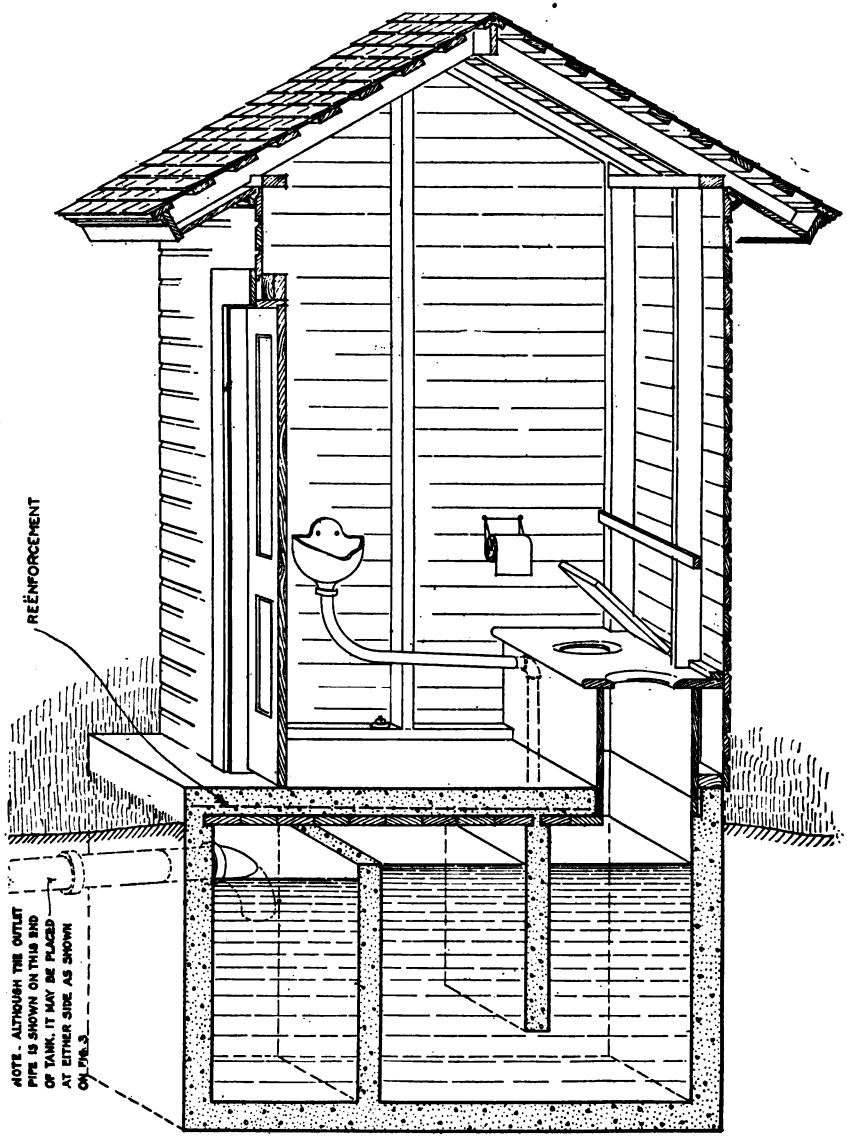

FIG. 1

VERTICAL SECTION OF TANK AND HOUSE

KENTUCKY SANITARY PRIVY

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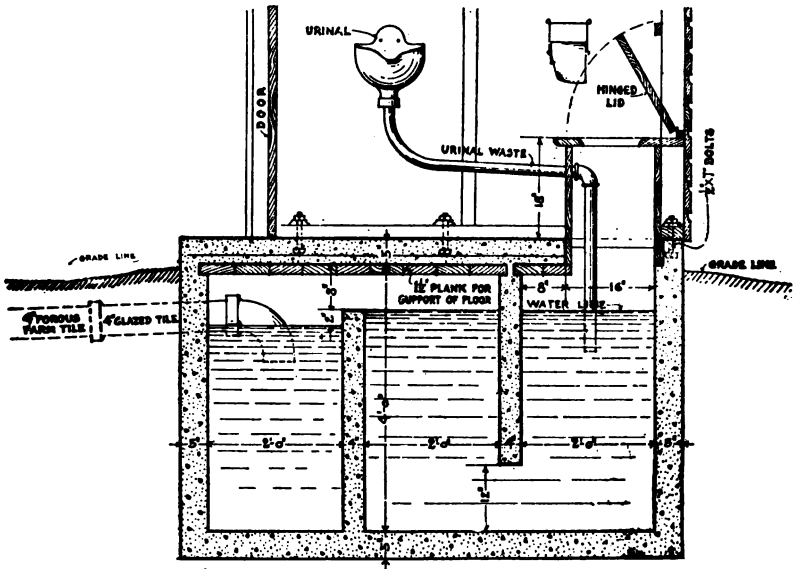

FIG. 2

VERTICAL SECTION

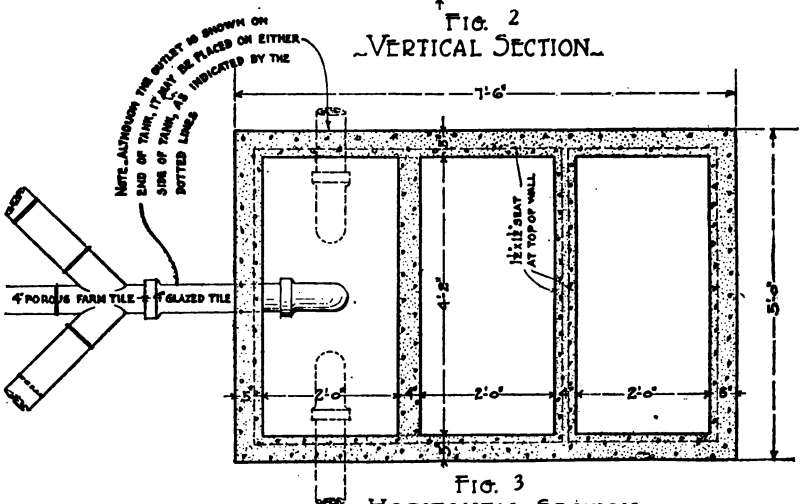

FIG. 3

HORIZONTAL SECTION

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Construction of Tank.

The outside dimensions of the tank are 7′ 6″ long, 5′ wide and 4′ 10″ deep. It should be water-tight when completed; if not, the ground around it will become foul with impurities and the tank will be no better than a cesspool. Concrete is recommended for permanence and can be made thoroughly water-tight. The proportions of materials for making the concrete are: Cement, one part; sand, two parts; and crushed rock or gravel, four parts. For a tank of this size, there will be required 15 sacks of cement, 1 yard of sand and 2 yards of gravel.

After the walls have set for three days, the forms may be removed and every portion of the interior should be plastered with a rich mixture composed of equal parts of cement and sand.

The top should be re-enforced with galvanized iron rods or wire to give greater strength. Bolts for fastening buildings to tank and also the pipes leading into and out of the tank should be put in place while the concrete is being poured.

The Tile Drain.

As shown in the cuts, the first or curved joint of the drain should be of glazed tile, and the inner end should go well into the water to make it an effectual trap. As shown in figure 3, the drain may extend from the front or either side of the tank as will best suit the lay of the ground. The porous farm tile for the drains should extend 100 feet, more or less, depending upon the character of the soil, usually branching out as shown in figure 3. It should be laid below the frost or freezing line away from the spring or well, should discharge entirely under ground, never opening to the air at the end or any other point, and the surface over the drains should be utilized for a flower bed or rose garden, getting the benefit of the constant irrigation and fertilization, thus converting into a thing of beauty and pleasure what has heretofore always been a malodorous source of danger.

Where the tile can not be obtained, ditches eighteen inches wide and two and a half feet deep, extending the same distance as the tile drains and with the same fall, and filled half way up or more with rock about the size of the fist, over which flat stones are carefully laid and the joints well broken before the whole is covered with earth, will make a good substitute for tile drains, and probably answer the purpose nearly as well. In clay soils, rock placed around and over the tile drains in the same way will ensure better drainage. In using the stone-filled drains, it should be well remembered that the first or curved glazed joint of tile is essential and in all cases must be in place in the forms before the cement for the walls goes in.

Filling and Inoculating the Tank.

Before the house is put in place and bolted down, the tank should be filled with water, five or six shovelsful of old, well-rotted horse manure should be put in to inoculate the fluid with the liquefying, purifying germs upon which everything depends, a supply of toilet paper should be provided, and the privy is ready for use.

The Urinals.

The urinals shown in the cuts are intended only for private homes or other places where they will be used by a small number of persons. For privies, schools, court houses or similar places to be used promiscuously by boys and men, most of them more or less careless, glazed iron troughs should be substituted for the urinals, and always should be placed in properly latticed sheds at the back or side of the privy, with the pipes extending through the wall and seat and well down into the water as shown in the cuts, and with the additional care as to daily flushing and cleanliness in proportion to the number of persons using them.

Location and Care of Premises.

The septic tank should drain away from the well or spring. At least four gallons of water should be poured through each hole in the seat and through each urinal each day. This must be attended to with great care, or a very objectionable odor will result. Toilet paper only should be used, as heavier paper will help to fill the tank. The premises should be kept scrupulously clean.

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Cost.

The cost of materials for the construction of the tank and drainage system, in Fresno, is about as follows:

15 sacks cement at 80 cents	$12 00
1 yard sand	1 50
2 yards gravel	3 00
4 feet glazed tile	40
100 feet porous tile	10 00
Total	$26 90

SEPTIC TANK No. 2.

Fresno State Normal School type. Designed for water-pressure systems.

The plans herewith submitted are designed for country schools and farm houses that have water-pressure systems. A considerable number of such places in the rural districts of this section of California have installed windmills, gas engines or electric motors for pumping, and it is to meet this need that this plan is presented.

Construction of Tank.

The outside dimensions of the tank are 10′ 6″ long, 4′ 10″ wide and 5′ 10″ deep. It should be water-tight when completed; if not entirely so, the ground around it will become foul with impurities, and the tank will be no better than a cesspool. Concrete is recommended for permanence and can be made thoroughly water-tight. The proportions of materials for making the concrete are: Cement, one part; sand, two parts; and crushed rock or gravel, four parts. For a tank of this size, there will be required 33 sacks of cement, 1½ yards of sand, and 2⅔ yards of gravel. The size of tank here given will probably be large enough for most rural schools and farm houses. In the case of large schools, the dimensions of tank may be increased.

After the walls have set three days, the forms may be removed and every portion of the interior should be plastered with a rich mixture composed of equal parts of cement and sand.

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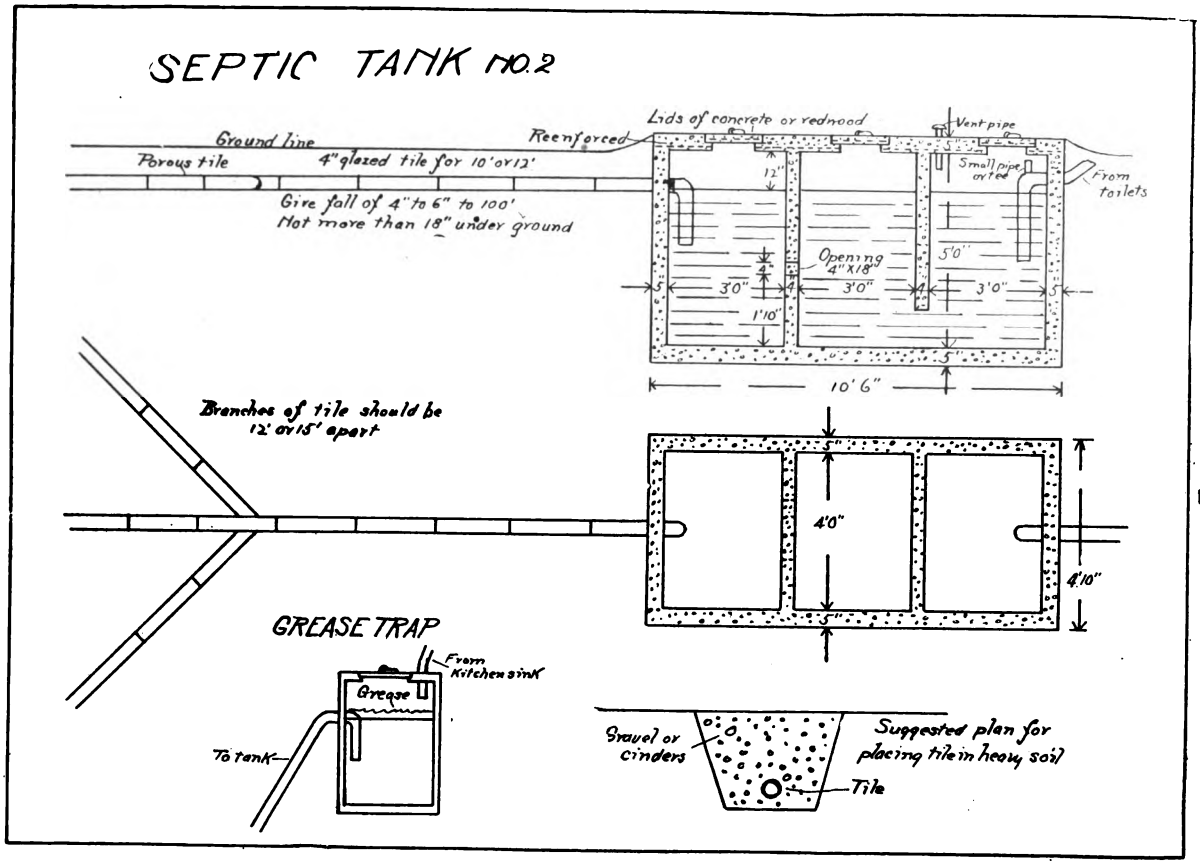

Fig 4

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The top, and also the lids if made of concrete, should be re-enforced with galvanized iron rods or wire to give greater strength. The lids should be cemented when put in place to make the tank as nearly airtight as possible and to keep children and others out of it.

The pipes leading into and out of the tank should be put in place when the concrete is poured. A short piece of pipe or a tee is used at elbow on intake pipe from toilets for the purpose of making cleaning of pipe easy in case of obstruction. A small vent pipe for the escape of gas is placed in the top of first compartment.

The Tile Drains.

The tile drains for the first ten or twelve feet from the tank should be glazed and cemented together. This is done in order to make this section water-tight. The remainder of the tiles are porous, loosely jointed, and should be placed under ground not more than eighteen inches, and drainage will be better if they are placed only twelve inches below the surface. The fall of the entire drainage system should be from 4″ to 6″ to 100′. The amount of tile required will vary from 100′ to 300′ depending on the character of the soil. The lighter and more sandy the soil, the less pipe is required. In unusually heavy soil, it is advisable to first dig the trench to the required depth, place the tile and fill the trench with gravel or cinders. The drainage system may be laid straight or branch to suit the ground available or the contour of the land. Flowers or grass planted above distributing tile drains will increase the efficiency of the general system.

Inoculating the Tank.

When the tank is completed and filled with water, five or six shovelsful of well-rotted horse manure should be put into it to inoculate the fluid with the liquefying, purifying germs upon which is everything depends. Toilet paper only should be used, as heavier paper is dissolved with much more difficulty and simply helps to fill the tank with refuse, making frequent cleaning necessary.

Urinals.

For schools and other places that may be used promiscuously by men and boys, most of whom are careless, urinals should be installed.

Kitchen Sinks and Bath Tubs.

The kitchen sink may drain into the tank provided the grease trap is used. A simple form is indicated in figure 4, using a barrel or concrete structure for the purpose. As the grease accumulates it can be skimmed off from time to time. Water coming from tubs should also be well trapped. In all cases, where kitchen sinks and tubs are discharged into the tank, pipes should be carried above the roof for proper ventilation.

Cost.

The materials required for the construction of the tank and drainage system here described, will cost, in Fresno, about as follows:

33 sacks cement at 80 cents	$26 40
1½ yards sand	2 00
2⅔ yards gravel	3 75
12 feet glazed tile	1 20
200 feet porous tile	20 00
Total	$53 35

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FRESNO STATE NORMAL SCHOOL

BULLETIN No. 4

WOODWORK

FOR THE GRAMMAR GRADES

FRESNO, CALIFORNIA
APRIL, 1917

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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WOODWORK

AND

Mechanical Drawing

FOR

Rural and Town Schools

By W. B. GIVENS

Department of Mechanical Arts
Fresno State Normal School

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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TO THE TEACHER.

This bulletin is issued largely on account of requests that have come for specific information both in regard to the equipment required for woodwork in rural and town schools and for definite suggestions on courses that are suited to such schools. The course, as outlined, is suggestive only. It is the result of teaching the subject in the public schools for a number of years Other projects may be substituted or added, but should be placed according to some definite plan of progression. The class work should be planned as is the work in any other subject.

The tools recommended are standard in quality, and the writer does not advise the purchase of any other sort. When necessary, either list may be decreased to some extent and still the course, as a whole, carried out.

Tool processes should be explained and demonstrated so that the various operations are performed in approved ways. Such oral instruction should be given as the work demands. Usually such talks should not exceed ten minutes. Other related matter, such as lumbering, growth of trees, industrial uses of wood, etc., should be given in short talks from time to time according to plan.

It will be noticed that the outlines of work are brief. Such a course presupposes some training of the teacher in the subject. Mechanical drawing should be made a part of the course. Drawing is so essential in all construction work, that the pupil should know the fundamentals of simple drawing, and should acquire the ability to read such drawings as are required for the work of the shop.

For the guidance and help of the teacher, a list of books is subjoined that will be found most helpful. There is a growing library on Manual Training, and the list below contains only a few of those that might be included.

"Grammar Grade Problems in Mechanical Drawing"—*Chas. A. Bennett.*
"A Textbook of Manual Training"—*William Paul Fox.*
"Problems in Farm Woodwork"—*Samuel A. Blackburn.*
"Projects for Beginning Woodwork and Mechanical Drawing"—*Ira Griffith.*
"Beginning Woodwork at Home and in the School"—*Clinton S. Van Deusen.*
"Wood and Forest"—*William Noyes.*
"Essentials of Woodworking"—*Ira S. Griffith.*
"Handwork in Wood"—*William Noyes.*
"Manual Training for the Rural Schools"—*Louis M. Roehl.*

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MANUAL TRAINING FOR THE RURAL SCHOOLS.

Manual training, for the most part in the form of woodwork, has a place in nearly every town or city school in the country. Even in towns that are quite small, those in control of their school policies believe that manual training should form a part of the curriculum. Less than ten years ago, all the manual training carried on in Fresno County was taught by one man in the city of Fresno. At the present time such courses are maintained in a majority of the thirteen high schools of the county and in most of town elementary schools. Even some of the rural schools have introduced the work and are carrying it on successfully.

The difficulty in using such courses in most rural schools, is, first, one of expense and, second, the proper adjustment of manual training to the other work of the school. If manual training is considered to be of such importance that it should form part of the educational experience of all children, some method should be found for making it a part of the work in the schools. It is with this hope that the present bulletin is issued. It is believed that a course in woodwork along the lines suggested herein can be maintained in schools of two or more rooms. It may be mentioned here that the course as outlined is only suggestive in the material offered. The essential part of such a course is the method of development from the educational standpoint; the particular projects can be varied greatly so long as some orderly method of development is maintained.

Equipment for Rural Schools.

The tools necessary for introducing this kind of work in a rural school need cost very little. Sets are suggested below. The character of the models selected for the course has determined a set of tools that will be found sufficient for every operation necessary for their production. If projects are introduced involving other processes of construction, a few additional tools may be necessary. When a particular make of tool is indicated, it is to be understood that this or some standard brand is to be selected. These particular ones are mentioned because the writer is familiar with them.

Minimum set of tools for rural school—

1 14-inch iron jack plane, No. 5.
1 10-inch back saw.
1 13-ounce forged steel warranted hammer.
1 6-inch graduated iron try square.
1 adjustable marking gauge.
1 No. 18—2 foot boxwood rule.
1 each $\frac{3}{8}$" and $\frac{1}{4}$" firmer socket chisels.
1 Sloyd knife.
1 $2\frac{1}{4}$" x 6" mallet.

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1 9-ounce bench brush.
1 4″ Champion screw driver.
1 set (13) auger bits, ¼″—1″.
1 8″ ratchet brace.
1 rose head countersink.
1 razor blade 8″ drawing knife.
1 No. 52 spokeshave.
1 26″ rip saw.
1 26″ crosscut saw.
1 6″ coping saw with 1 doz. extra blades.
3 Atkins steel cabinet scrapers.
3 10″ half round cabinet files.
1 steel 24″ framing square.
6 6″ malleable iron clamps.
6 36″ Sheldon spring steel bar clamps.
1 2″ x 6″ India oil stone.
1 3″ bronzed oil can.

This set can be purchased in Chicago for $25, weight about 90 pounds.

Moderate equipment for a rural school—

1 Simond's crosscut saw, 24″.
1 Simond's rip saw, 24″.
1 Disston back saw, 10″.
1 Turning saw in frame, 12″.
1 Coping saw, 6″.
1 saw set.
1 Stanley jack plane, No. 5.
1 Stanley block plane, No. 15.
1 Stanley spokesleeve, No. 52.
1 Maydole claw hammer, 13 oz.
1 Hickory mallet, 3″ face.
1 Buck Bros. socket firmer chisel 1″.
1 Buck Bros. socket firmer chisel ½″.
1 Buck Bros. socket firmer chisel ⅛″.
1 Combination carborundum stone, coarse one side, fine other, 8 x 2 x 1″.
1 Set Russell Jennings auger bits (13) ¼″ to 1″.
1 Drill bit for wood, No. 2.
1 Drill bit for wood, No. 4.
1 Drill bit for wood, No. 6.
1 Rose countersink ⅝″.
1 Barber's ratchet brace 8″ sweep.
1 Stanley screw driver, 6″ blade.
1 Sargent steel square, No. 1.
1 Stanley try square, No. 20, 6″.
1 Stanley marking gauge, No. 90.
1 Starret spring divider, No. 80, 6″.
1 pr. side cutting pliers, 8″.
2 Jorgensen hand screws, open 10″.
2 Taylor cabinet clamps, steel, 3′.
1 Zinc oiler, ½ pt.
1 File card.
2 half round wood files, 10″.
1 square wood file, 10″.
1 round wood file, 10″.

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1 Mill file, 10".
2 Slim taper saw files, 6".
1 Sloyd knife, 2¼" blade.
1 Cabinet scraper, 2 x 6".
1 Nail set, knurled, 1/16".
1 Bench duster, 8" block.
1 Brad awl, 1½".

This set of tools can be purchased in Fresno at the present time (April 1, 1917) for $40. This list will be sufficient where two or three pupils work at the same time. If more than this number, it will be necessary to increase certain of the tools listed. The following also are desirable additions to any woodworking shop; as the work becomes more extensive they may be considered indispensable:

1 Godell miter box, 5"	$13 25
1 Stanley rabbet plane and filletster, No. 78	2 50
1 Carpenter's drawing knife, 8"	95
1 Buck Bros. socket firmer gouge, ¾"	75
1 Buck Bros. socket firmer gouge, ½"	60
1 Grindstone	6 50
1 Stanley auger bit gauge, No. 49	50
1 Maple rule, 12"	25
1 Stanley sliding T-bevel, 6"	25

Home-made Benches.

A very satisfactory bench can be made at small cost by a carpenter. Two types are suggested—one a double bench, and the other a long bench built along the wall. The top should be made of two-inch lumber. Also, the parts should be bolted together, rather than jointed with nails or screws. Such benches will be found very serviceable.

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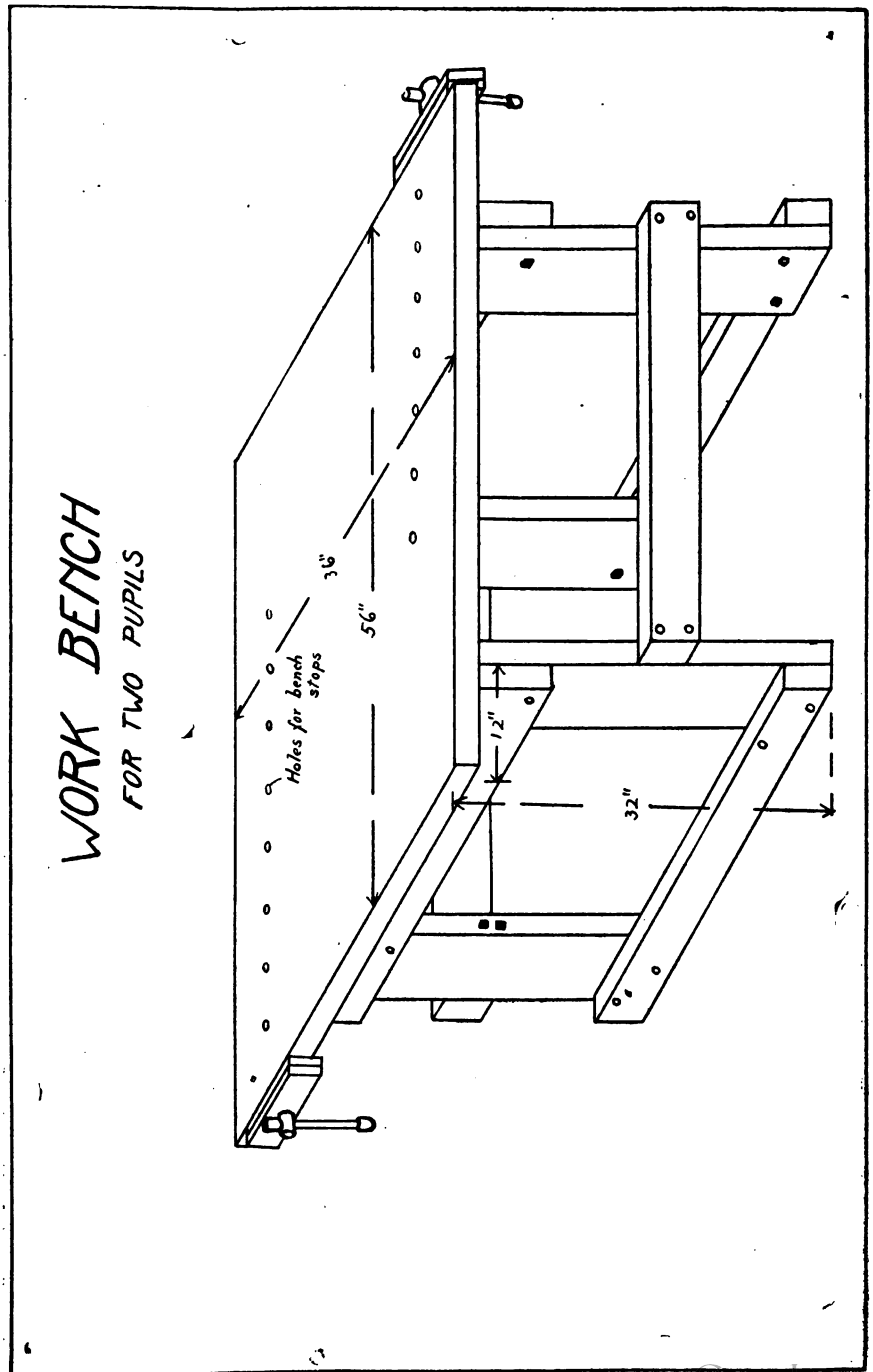

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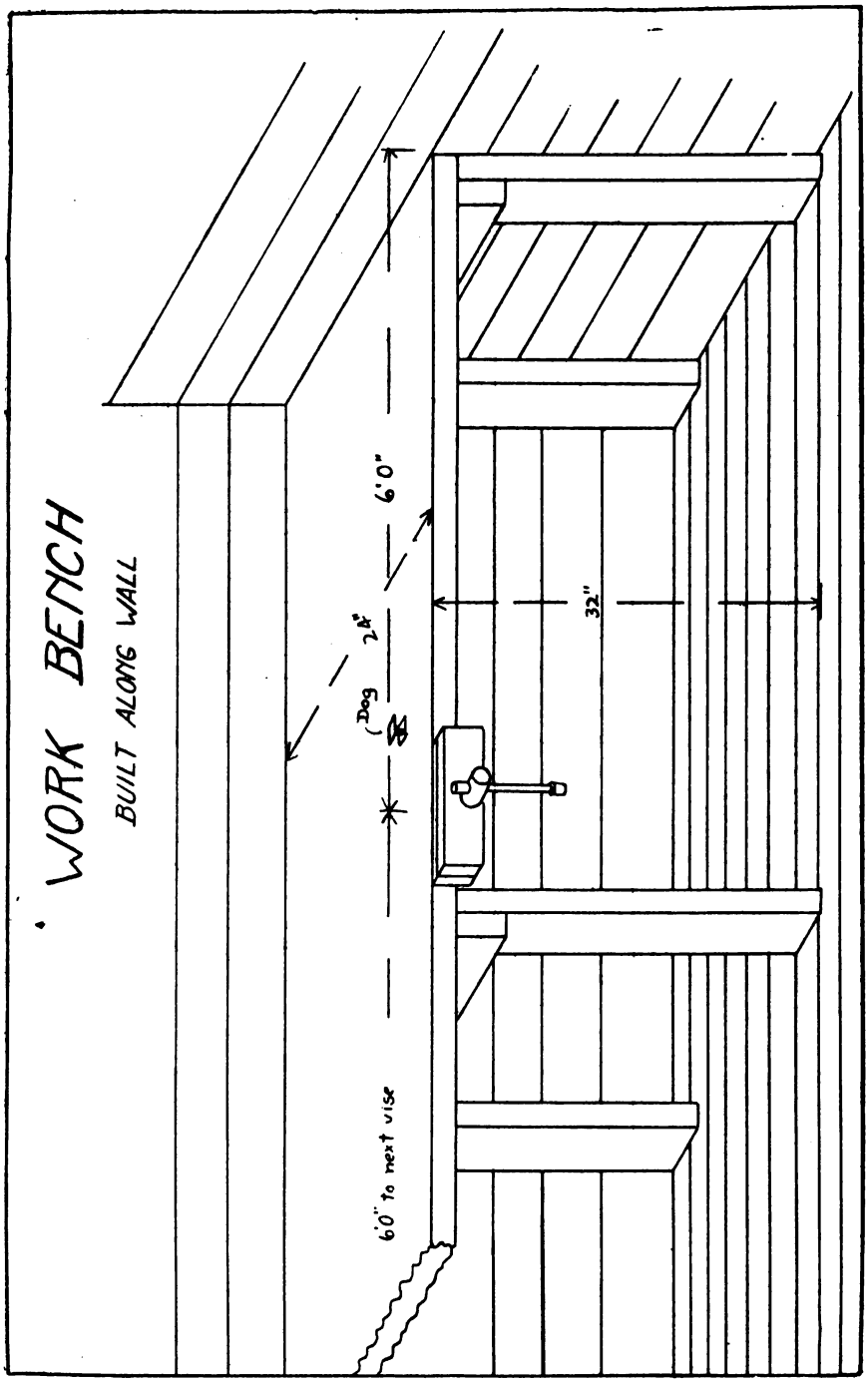

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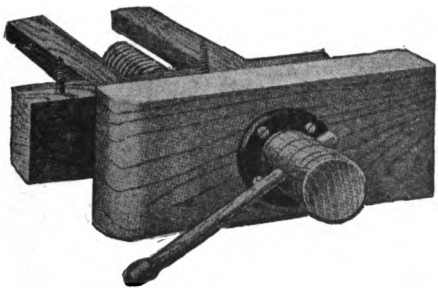
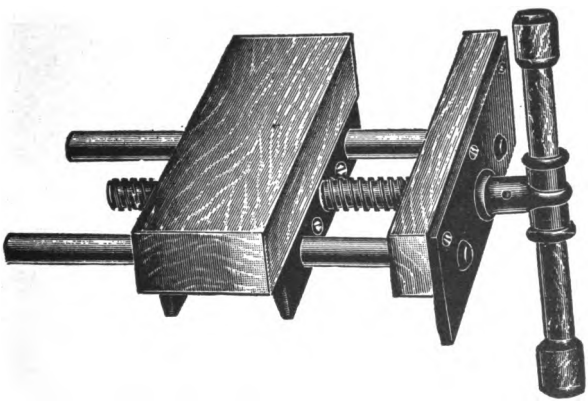
The cuts and prices of both a maple vise and a continuous steel screw vise are included. There is a cheaper iron vise made than the one shown, but it is not recommended, as experience has shown that it is very short lived in a manual training shop. A considerable number of rapid acting vises are on the market, several of which are excellent in action and moderate in price.



Wood screw vice. Price f. o. b. Chicago, $1.14.



Steel screw vice. Price f. o. b Chicago, $1.92.

EQUIPMENT FOR VILLAGE OR TOWN SCHOOL.

The following list of tools is suggested as a moderate equipment for a class of ten:

2 Simonds rip saws, 24".
2 Simonds cross cut saws, 24".
10 Disston back saws, 10".
2 Turning saws in frames, 12".
2 Coping saws, 6".
1 Saw set.
1 Godell miter box, 6"
10 Stanley jack planes, No. 5.
10 Stanley block planes, No. 15.
1 Stanley rabbet plane and filletster, No. 78.
10 Stanley spokeshaves, No. 52.
2 White drawing knives, 8".
4 Maydole claw hammers, 13 oz.
2 Hickory mallets, 3" face.

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10 Buck Bros. socket firmer chisels, ¾".
10 Buck Bros. socket firmer chisels, ½",
2 Buck Bros. socket firmer chisels, ⅛".
2 Buck Bros. socket firmer chisel gouges, ¾".
2 Buck Bros. socket firmer chisel gouges, ½".
1 Carborundum stone, 8 x 2 x 1", coarse.
1 Carborundum stone, 8 x 2 x 1", medium.
1 Carborundum stone, 8 x 2 x 1", fine.
1 Grindstone.
1 Set Russell Jennings auger bits (13), ¼" to 1".
2 Drill bits for wood, No. 2.
2 Drill bits for wood No. 4.
2 Drill bits for wood No. 6.
2 Rose countersinks, ⅝".
2 Auger bit gauges, Stanley No. 49.
3 Barber's ratchet braces, 8" sweep.
4 Stanley screw drivers, 6" blade.
2 Sargents squares, No. 1.
10 Stanley try squares, No. 20, 6".
1 Stanley sliding T-bevel, 6".
10 Maple rules, 12".
10 Stanley marking gauges, No. 90.
10 Starrett dividers, 6", No. 80.
1 Side cutting pliers, 8".
6 Jorgensen hand screws, open 10".
6 Taylor's steel clamps, open 3'.
1 Zinc oiler, ½ pt.
1 File card.
5 Half round wood files, 10".
1 Cabinet rasp, 10".
1 Square wood file, 10".
1 Mill file, 10".
4 Slim taper saw files, 6".
3 Sloyd knives, 2¾" blade.
4 Cabinet scrapers, 3 x 6".
6 Nail sets, 1/16".
10 Bench dusters, 8" block.
4 Brad awls, 1½".

This set of tools can be purchased in Fresno at this time (April 1, 1917) for $195.

Manual Training Benches.

Cuts of inexpensive but durable benches are included. A large number of manual training benches are on the market.

The cuts shown here were chosen because of their low cost and general excellence. Information on this subject will be furnished by the author or will be supplied by the various manufacturers.

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This bench, price f. o. b. Chicago, $7.84.

This bench, with continuous steel screw vice f. o. b. Chicago, $6.85.

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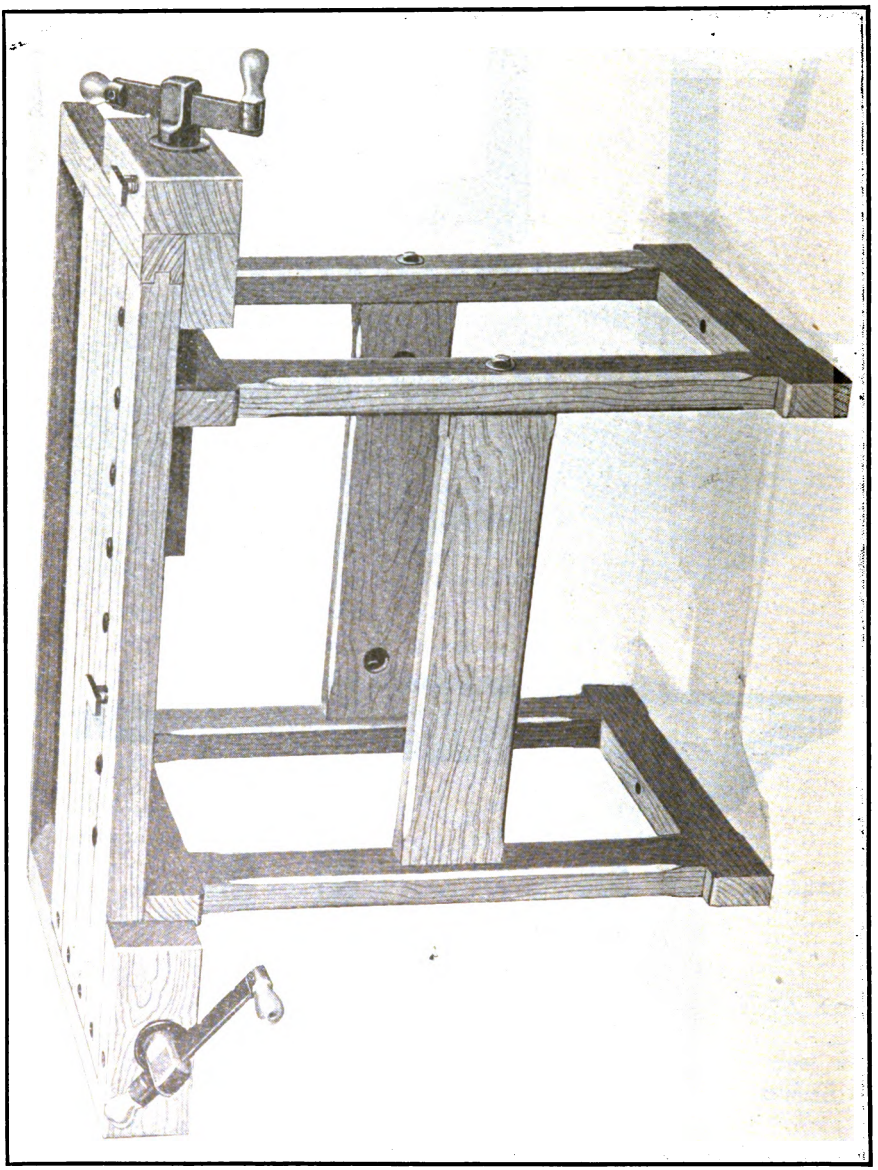

Price, with one vice, f. o. b. Muskegon, Mich., $5.50; with two vices, $6.50.

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WOODWORK AND MECHANICAL DRAWING FOR THE SIXTH, SEVENTH, AND EIGHTH GRADES.

SIXTH GRADE.

As drawing is such an important factor in all constructive work, it should be made a part of the manual training taught in the public schools. In the sixth grade, all the materials that will be required are: paper (9x12), pencil, eraser, ruler and pencil compass. Assuming that the paper is square, the drawings can be made to square with it. Explain the meaning of the different lines used as required. Unless an extra amount of time can be given to it, the drawing of the models to be made in the shop will consume the time allotted. A simple system of lettering should be developed. Some preliminary work should be done in studying the ruler, drawing lines of varying length, lines perpendicular to each other, etc.

Project I—Cutting Board.

Drawing: Draw margin one-half inch inside edges of paper. At top below margin, draw lines for lettering name of object. Draw two views of cutting board, putting dimensions with arrow points properly placed. At bottom, below margin, place name at left side and date on right.

Shopwork: As most boys in this grade will have had little experience and no instruction in handling tools, the teacher should explain the use of the different tools as needed and demonstrate their proper use.

Plane one long edge of board level and square. When this has been done to the satisfaction of the teacher, he may mark with pencil as approved. With try square, using leveled edge as base, draw line perpendicular to this edge. If there is much wood to be removed, use cross-cut saw to within one-eighth of an inch of line. Teach method of planing end of board without breaking edges. When end is squared with first side, teacher may mark with pencil. Measure exact length of board from square corner. Square with trued edge as before. Plane to line. When satisfactory, teacher may mark. Measure correct width of board from both square corners. Connect points with line; plane to line. Teacher should mark when approved. Finish with fine sandpaper, using sandpaper block on edges to keep them square.

Project II—Shrub Label.

Drawing: As this object is too long to be drawn to full scale, a "break" may be employed. Explain. Draw rectangle to contain side view. Measure off proper distances to get slant lines. Place dimension lines. Finish with name and date.

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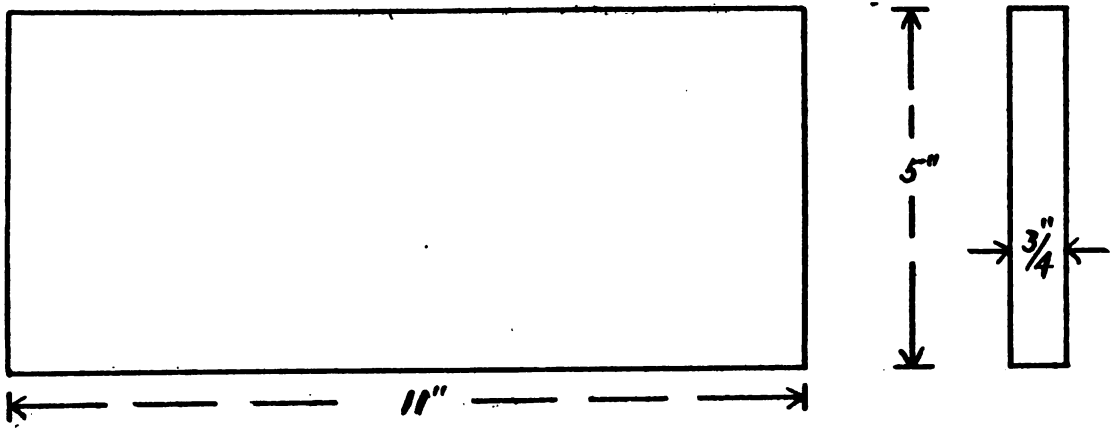
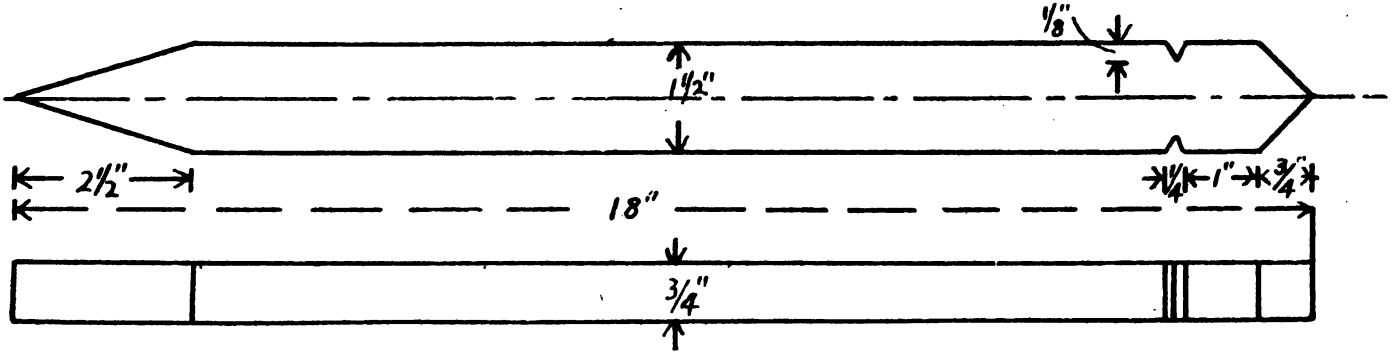
CUTTING BOARD



SHRUB LABEL



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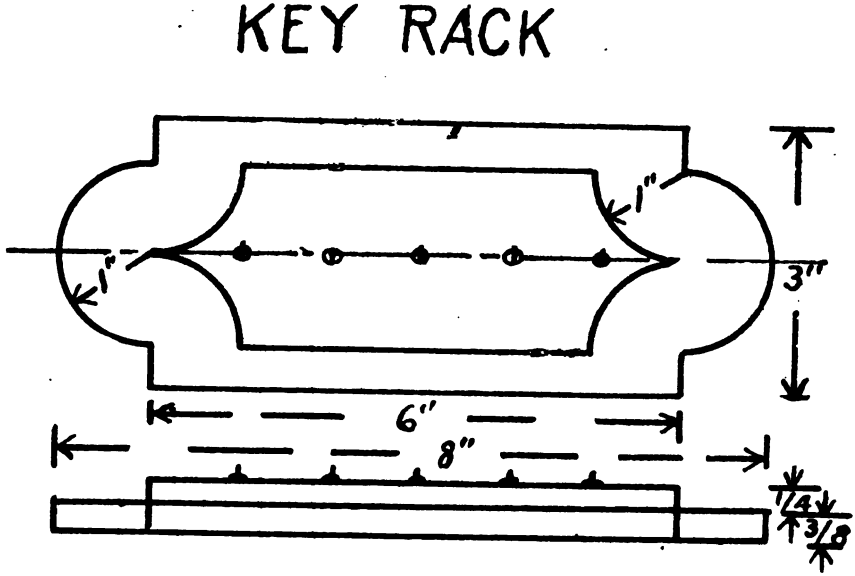
Shopwork: Cut out piece of board somewhat larger than finished dimensions. Square as indicated in Project I. To get sharp point, first saw to within $\frac{1}{8}$" or $\frac{3}{16}$" of line. Plane to line. To make notches, use chisel. Demonstrate before class. Learn names of tools on bench.

Project III—Key Rack.

Drawing: Proceed as indicated in previous drawings. Draw rectangle for front view. Place center line. Drop perdendiculars to run through center of circles. With compass, draw half-circles. Complete drawing.



Shopwork: Square board for back. Draw center line. Draw perpendiculars through center of circles. With dividers, draw half-circles. With back saw, cut to beginning of half-circle. Cut curve with coping saw. Square piece for front. With dividers, draw quarter-circles; cut with coping saw. Finish with file and sandpaper. Nail pieces together from back with brads. Oil and place hooks. Explain the principal difference between block and jack planes.

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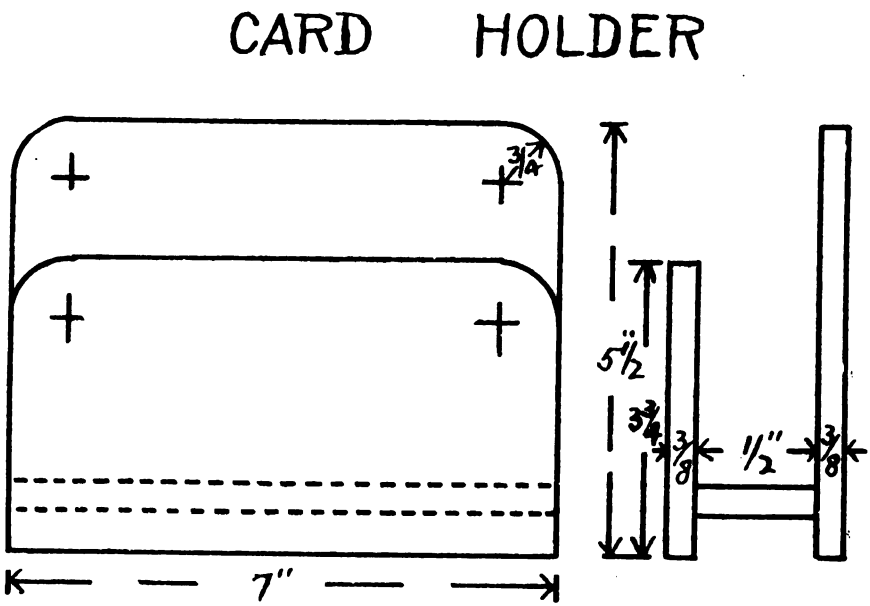
Project IV—Card Holder.

Drawing: Draw rectangle for front view. Draw center line. Explain meaning of "dotted line." Show that such line is really made of short dashes spaced equally. Complete drawing.



Shopwork: Square all these boards. With dividers, draw curves for rounded corners; cut with spokeshave. Teacher should demonstrate use of this tool before class. Oil or stain model. Teach pupils how to distinguish between rip and crosscut saws.

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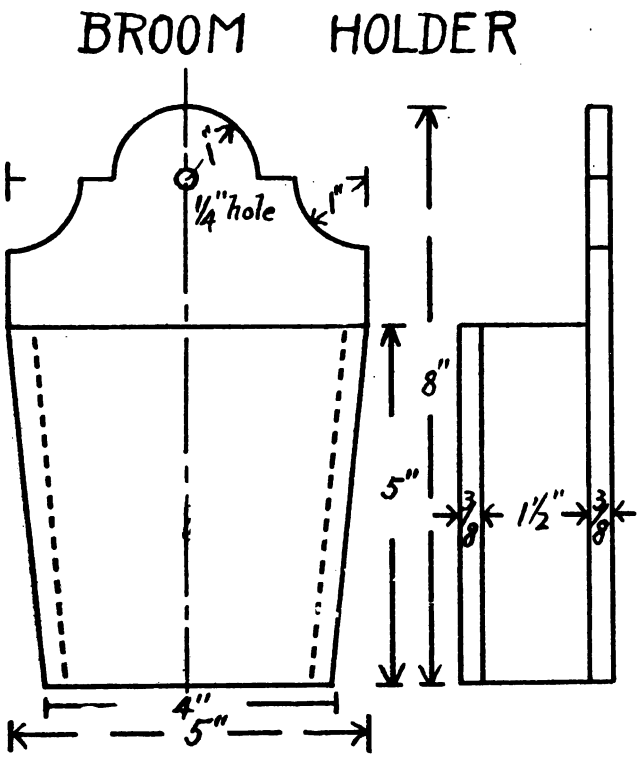
Project V—Broom Holder.

Drawing: Lay out plate as indicated heretofore. Draw rectangle for front view. Draw center line. Complete view. At right on extension lines, draw side view. Work out dimensions of all pieces.



Shopwork: Square all pieces. Draw center lines. Lay out with square and dividers. Cut out with saw and plane. Bore hole for hanging on wall. Demonstrate method of boring hole so as not to split out. Explain numbering of bits. Oil or stain model.

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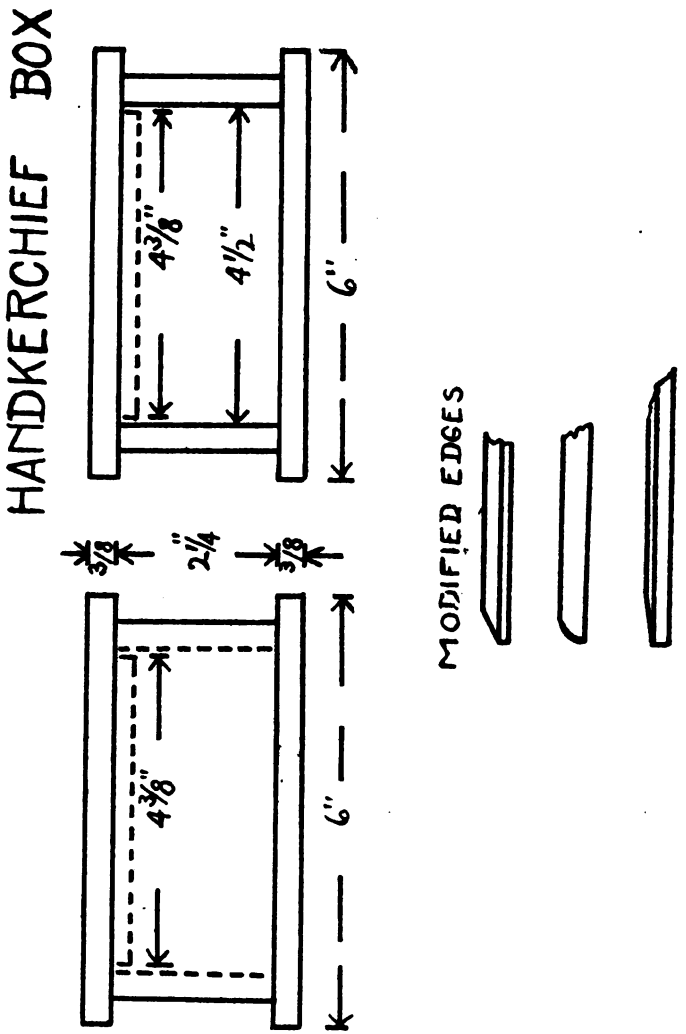
Project VI—Handkerchief Box.

Drawing: Draw rectangle for side view. On extension lines to right, draw rectangle for front view. Edges of top and bottom board may be varied. Such variation should be included in completed drawing. Work out dimensions of all pieces.



Shopwork: As this is the first problem in box construction, explain that all pieces must be of exact size or parts will not fit. Put together with brads. Name all tools in use in shop.

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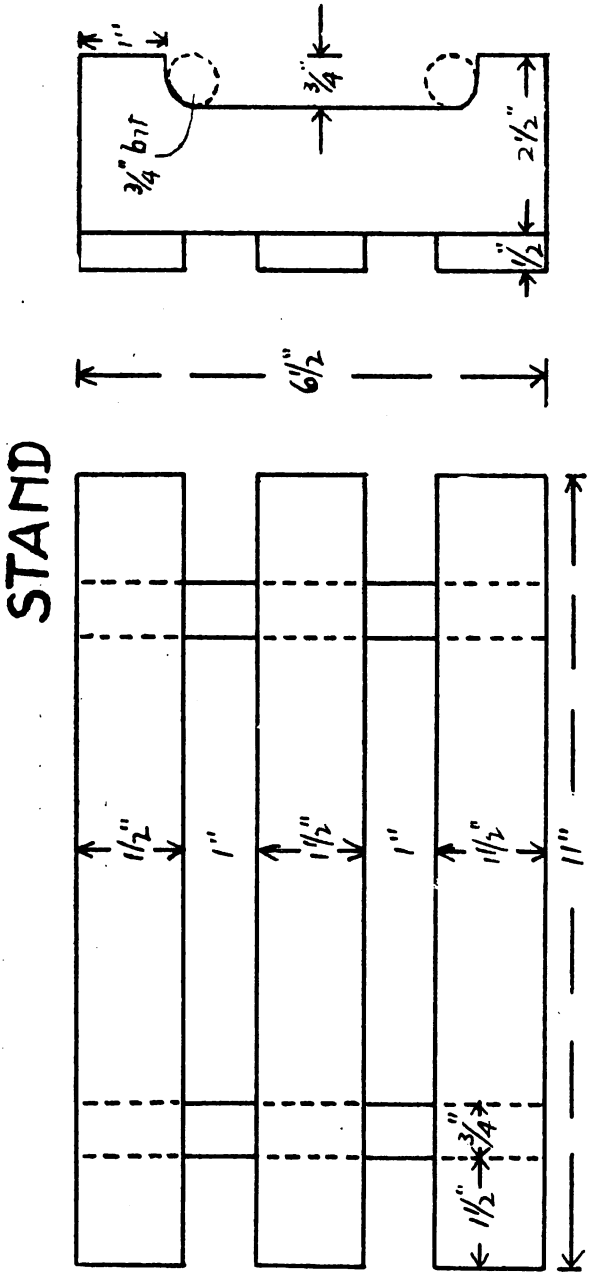
Drawing: Draw to half-scale. Work out dimensions of each piece. Explain why same line is both solid and dotted.



Shopwork: Square all pieces. Use sandpaper with block on edges of boards. Nail with brads. Finish with oil or stain. Name woods in use locally, noticing quality, color, etc.; find where each grows, size

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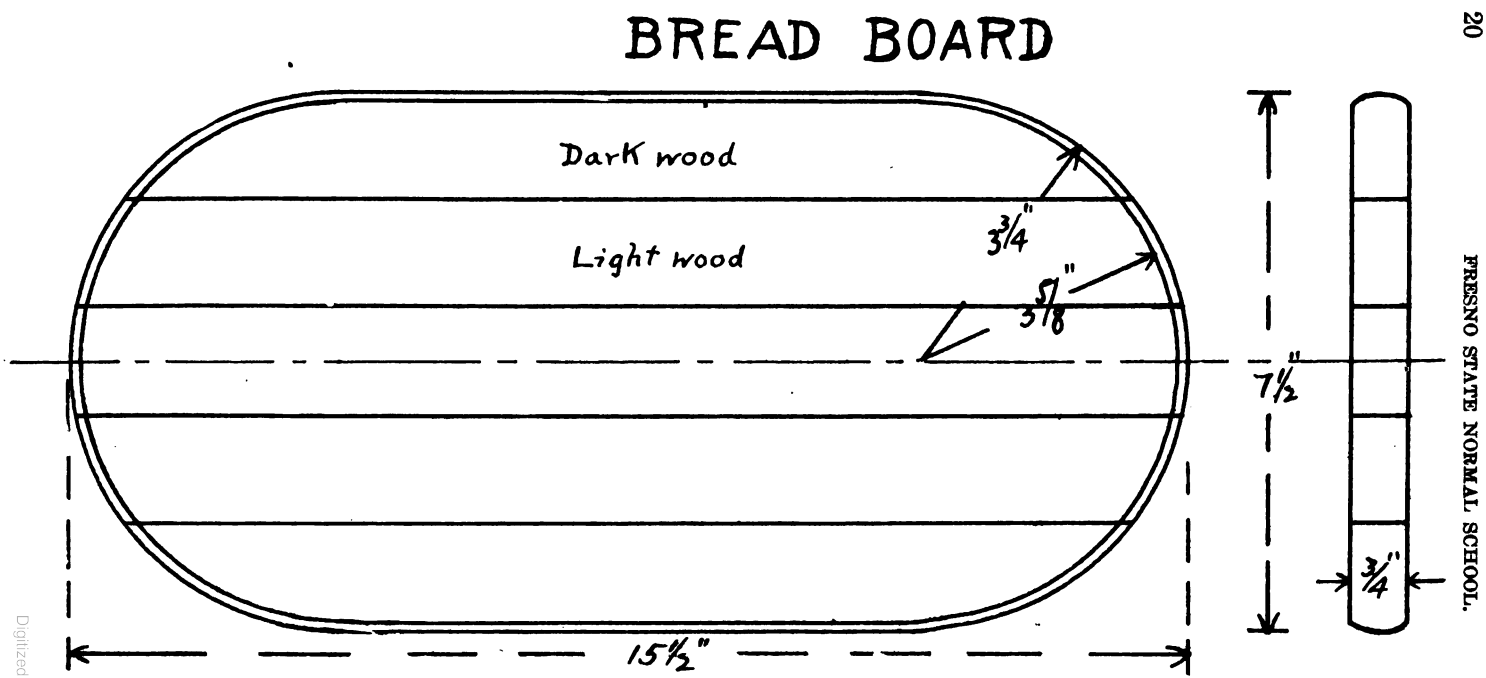

Project VIII—Bread Board.

Drawing: Draw rectangle for side view. Place center line. Drop perpendiculars through center of circles. Complete drawing.

Shopwork: Cut pieces somewhat wider than dimensions. Very careful planing must be done so that pieces will fit closely. Before gluing, see that hand screw brings pieces together in good joints. After parts are glued, the piece is finished as a whole. Round edge with spokeshave. Finish with oil or leave natural. Show how a chisel is sharpened on stone.

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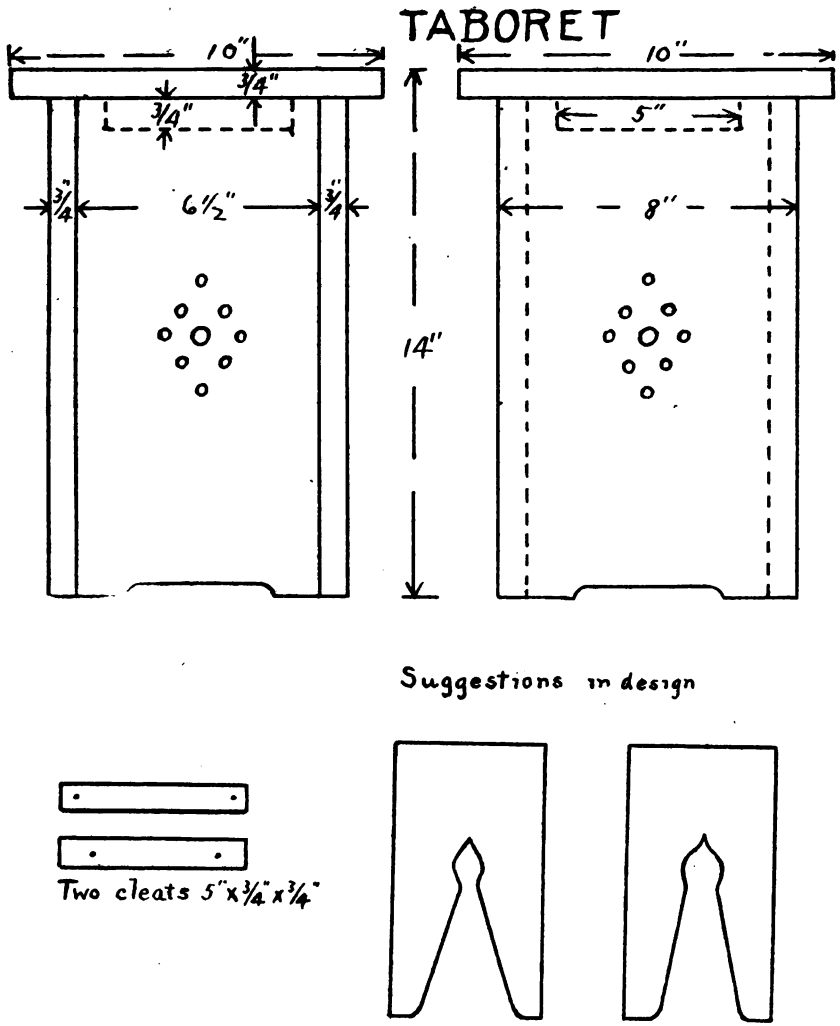
Project IX—Taboret.

Drawing: This piece may be made with considerable variation in design. Some time may be devoted to planning this part of the project.



Shopwork: Put sides together with round head screws. Screw top on by means of cleats underneath. Stain or oil and wax. Review tools and tool processes already discussed.

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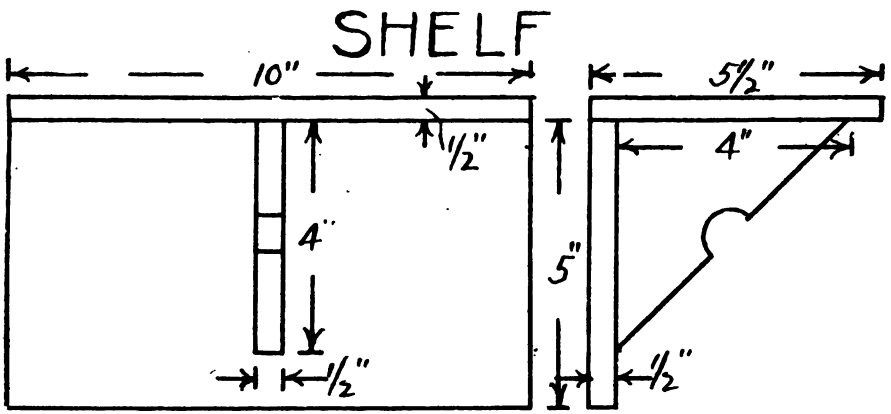
SEVENTH GRADE.

In order to secure the best results in drawing in seventh and eighth grades, drawing kits should be provided. A kit consisting of drawing board (13 x 19), T-square, 45° triangle and 30° 60° triangle can be purchased for 60 cents to 75 cents. Four thumb tacks will be required for holding paper on board. Paper 12 x 18 will be found satisfactory.

Project I—Shelf.

Drawing: The teacher should demonstrate the proper methods of using T-square and triangles; method of placing paper on board; proper way to draw horizontal lines, etc. Draw margin. This first plate may be devoted to developing a system of lettering. Place name at left side below margin; date on right.



Shopwork: The shelf given in the accompanying drawing may be constructed in the shop, after discussion in class. Work out dimensions of pieces. Review method for squaring a board. In making bracket, hole may be bored before final cut to diagonal is made. Put together with brads. Oil or stain and wax.

Project II—Sleeve Board.

Drawing: Draw to half-scale. Place name of object at top of paper below margin. See that horizontal and vertical lines are drawn in proper manner. "Dotted lines" should be made of short dashes, equally spaced. Work out dimensions of each piece. Place name and date.

Shopwork: Square all pieces. Draw center lines on boards used for top and bottom. Lay out top with dividers and square. Cut curve with turning saw $\frac{1}{8}$" from line. Finish curve with plane and spokeshave to line. With marking gauge draw lines for chamfer. Make chamfer with spokeshave. Put pieces together with screws, countersunk below surface. Leave in natural state. In some detail, explain construction of the different kinds of planes in the shop.

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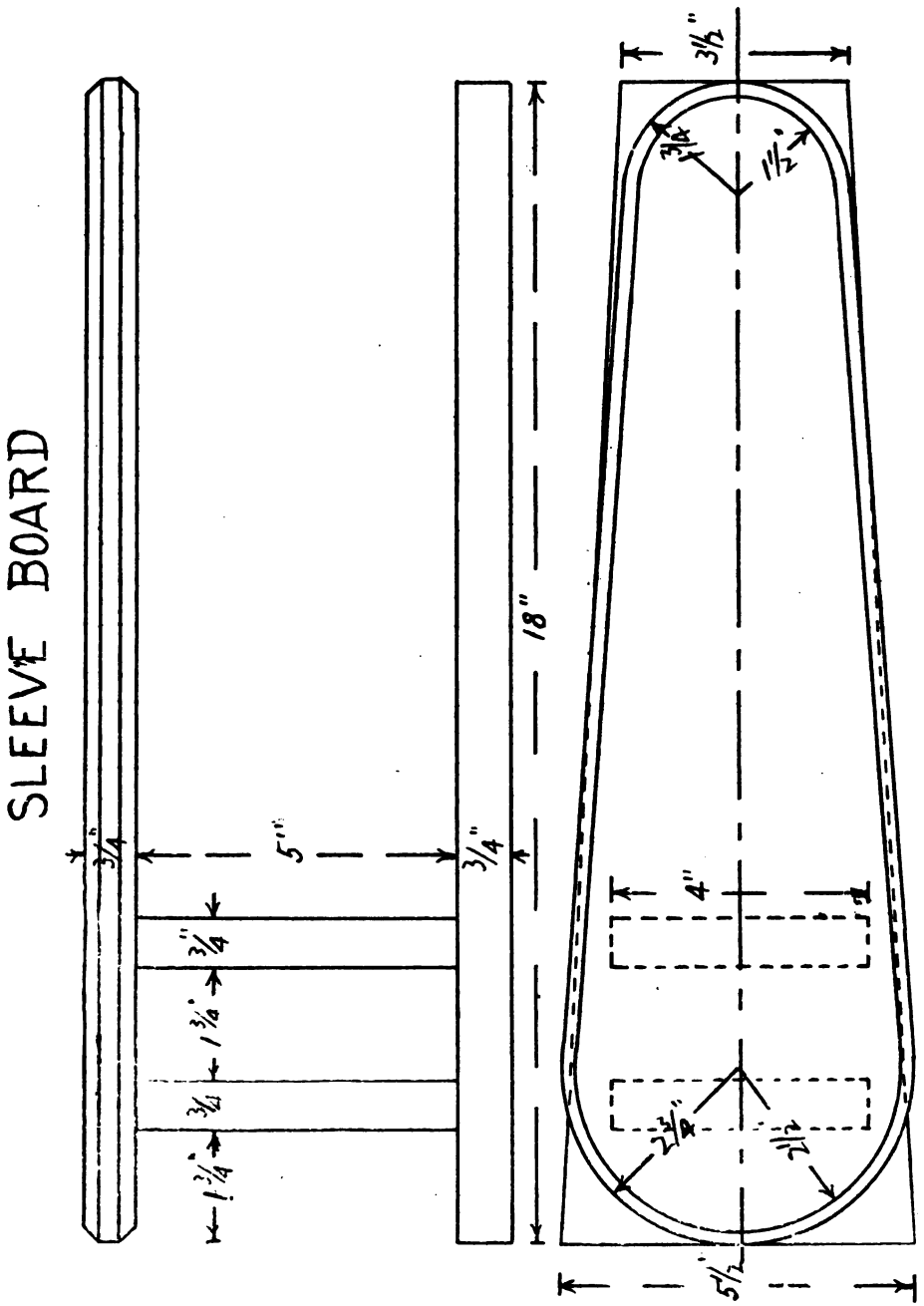

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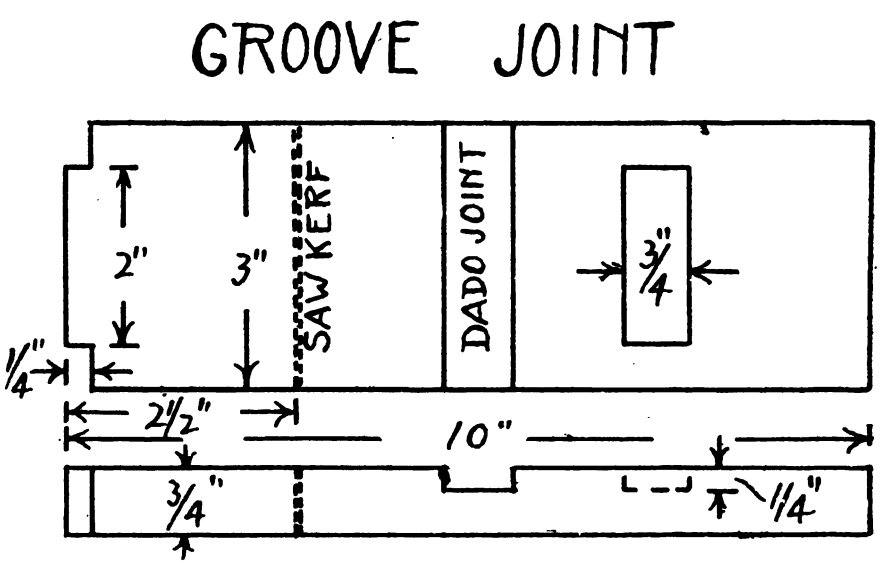
Project III—Groove Joint.

Drawing: Draw to full scale. Explain that parts of this model are made in one piece; when completed, the board is cut at place indicated. The test is to then see if parts fit. Place dimension lines with accuracy. Name and date.



Shopwork: Square piece. Lay out as indicated in drawing. Cut at line indicated. Good fit of joints should be demanded. Explain the difference in rip and crosscut saw teeth.

Project IV—Magazine Rack.

Drawing: Draw to half-scale. The design of ends may be varied to some extent. From the two views given, have pupils develop top view. Place name and date.

Shopwork: Square all pieecs. Cut grooves with chisel. With market gauge draw lines for chamfer. Make chamfers with spokeshave. Demonstrate method of using spokeshave across grain without splitting corners. Joints should be good. Sandpaper edges with sandpaper on block. Give talks on the cutting and seasoning of wood.

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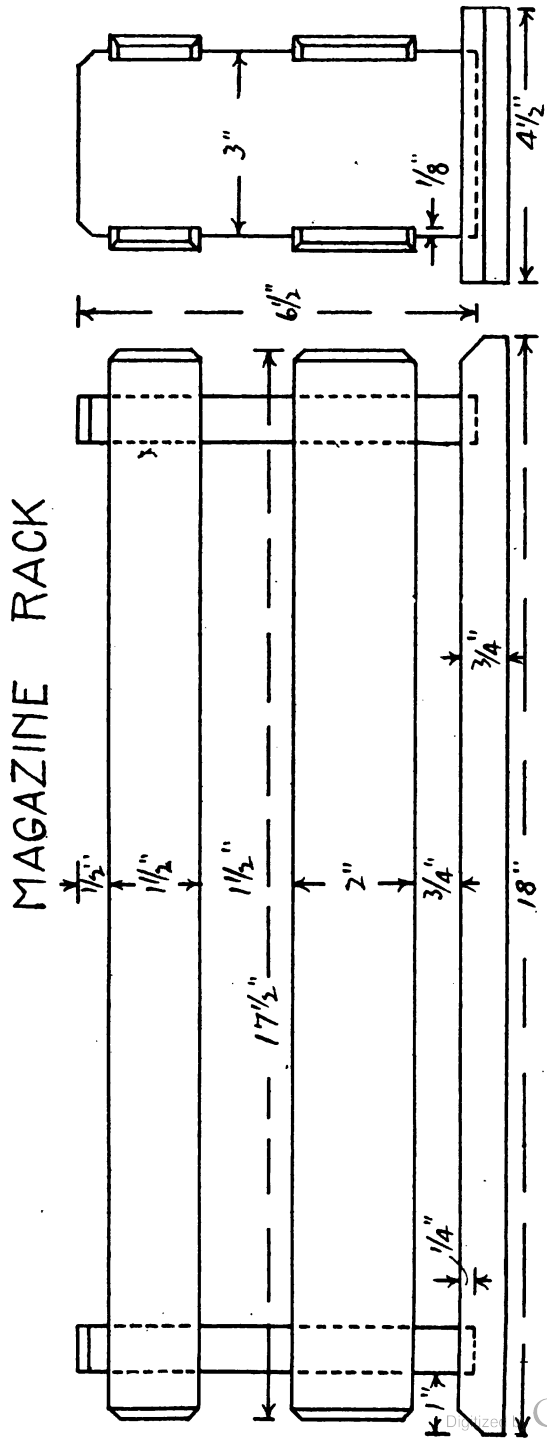

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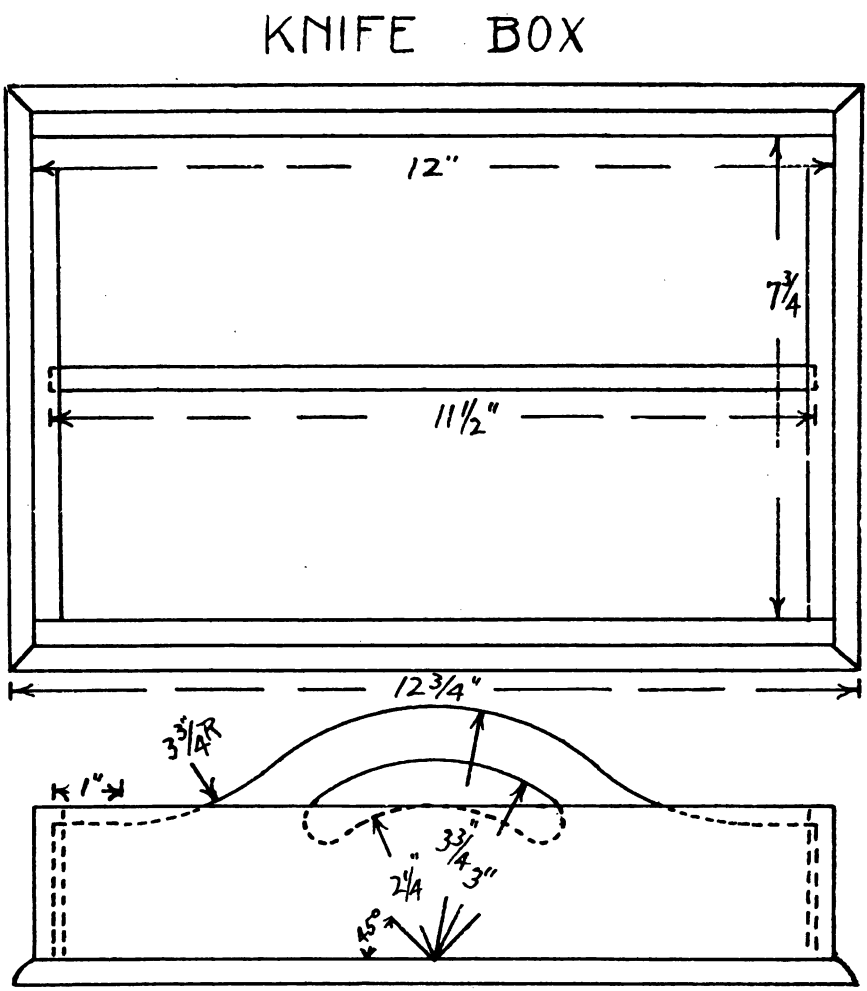
Project V—Knife Box.

Drawing: Draw to half-scale. When these two views are drawn satisfactorily, have pupils draw end view of box. Place dimensions with care. Name and date.



Shopwork: Square all pieces. When making hand-hold in handle, bore holes of proper size so that edge of bit will come at the right place. Complete with coping saw. Round edge of bottom board with spoke-shave. Continue talks on California lumbering.

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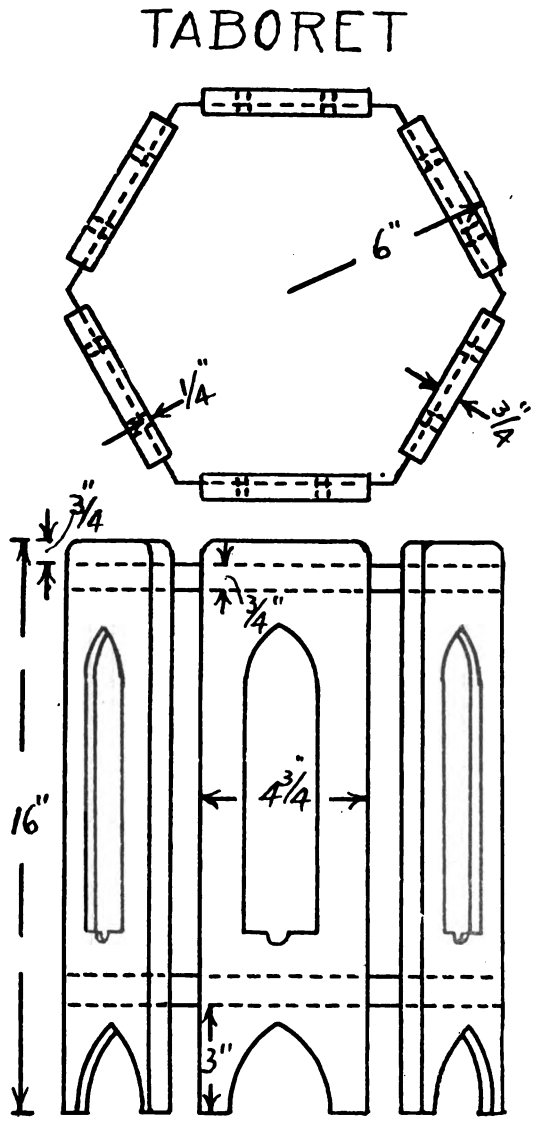
Project VI—Taboret.

Drawing: As a preliminary drawing to this plate, have pupils construct a regular hexagon. Draw taboret to half-scale. Complete top view first. Place hexagon so that one side can be projected in full width to view below. Explanation should be made of reason why width of some of the legs in side view is foreshortened. These foreshortened sides are found directly by projection from top view.



Shopwork: Lay out hexagon for top and for bottom shelf. Saw to $\frac{1}{8}''$ or $\frac{3}{16}''$ from lines. Plane to lines. To cut out design in sides, first bore holes, then introduce blade of turning saw. Finish with file and sandpaper. Legs must be of uniform length. Give talks on lumbering in Northern states.

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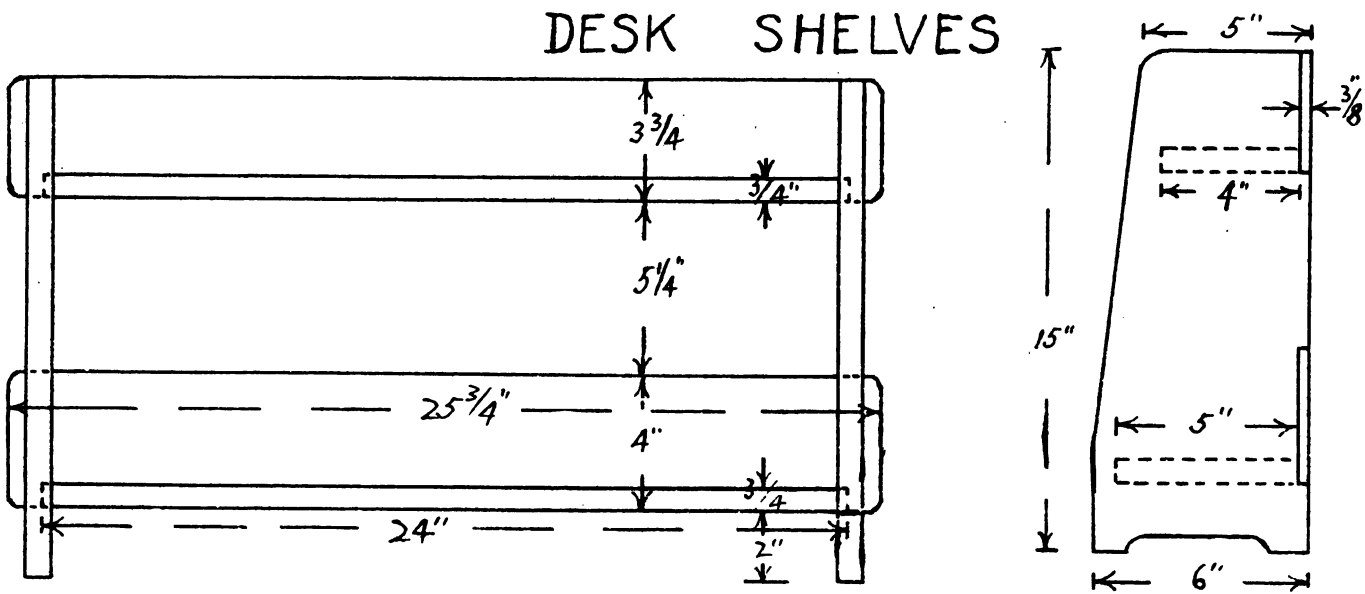
Drawing: Draw to quarter-scale. Complete in all details. As a second plate, an oblique drawing may be made from the views already made.



Project VII—Desk Shelves.

Shopwork: Work out dimensions of all pieces. Square each. Glue shelves in place and clamp. Put back boards on with screws. Oil or stain and wax.

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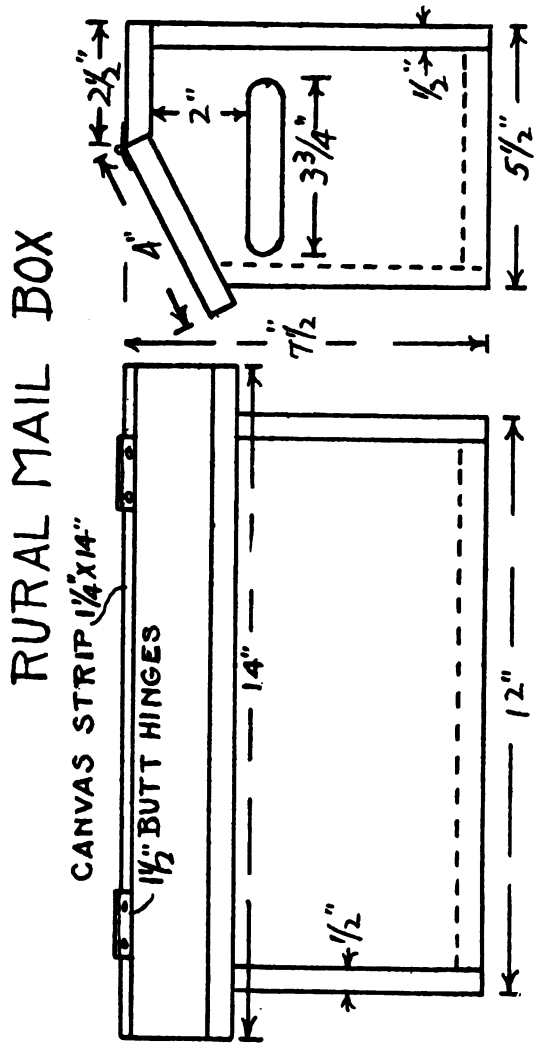
Supplementary Projects.

The rural mail box, egg tester, bench hook and fly trap are suggested as problems that are suitable for advanced pupils. Drawings should be made of the projects chosen, lettered and dimensioned. Have each pupil work out the three dimensions of each piece used in the construction of a particular model.



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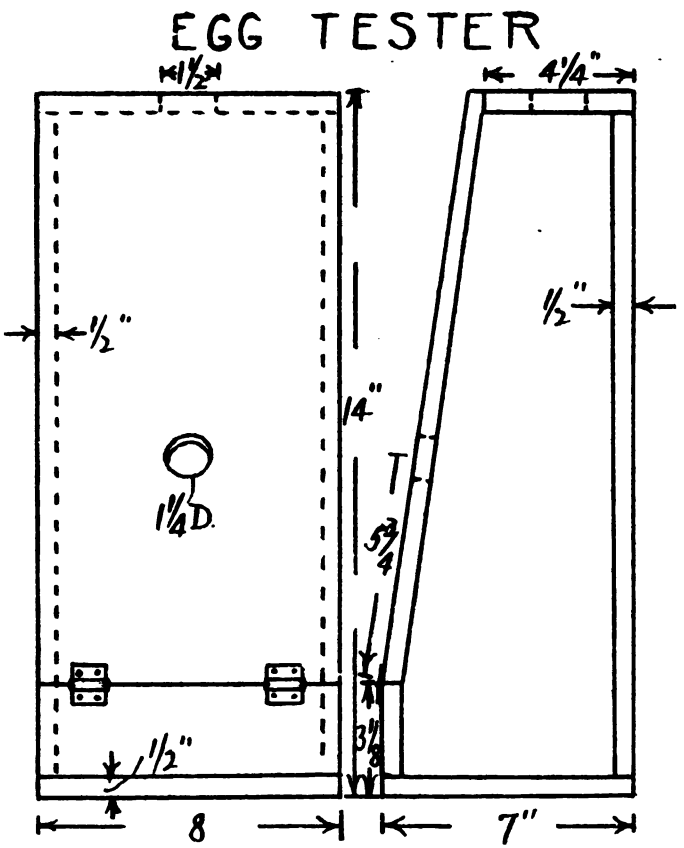

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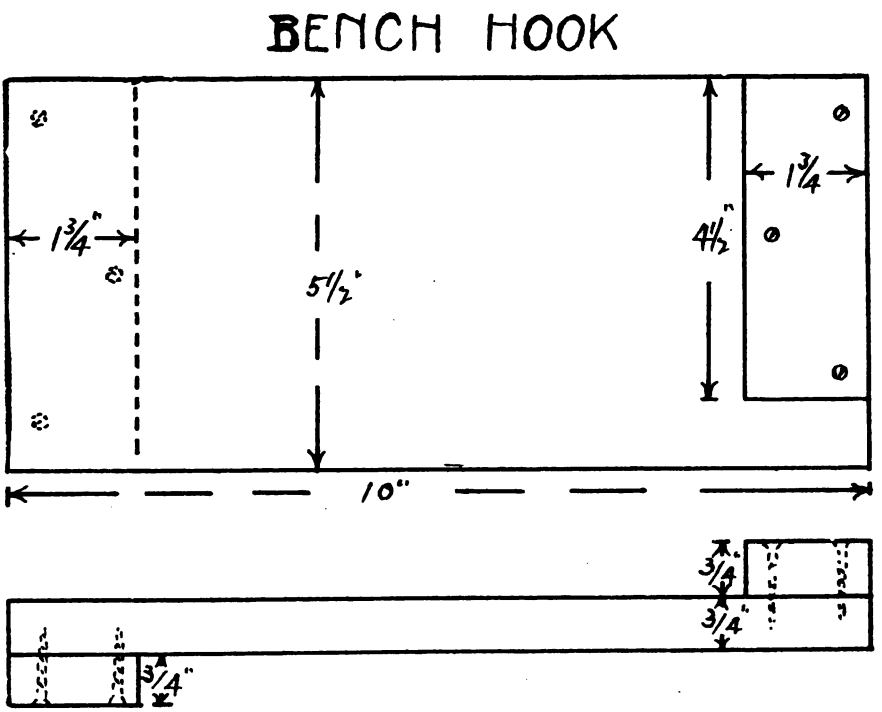

EIGHTH GRADE.

The drawing for the year is a continuation of the work of the seventh grade. The work becomes more complex as new problems are added. Pupils in this year should be able to interpret the ordinary working drawing with considerable certainty. Accuracy should be demanded in all work done.

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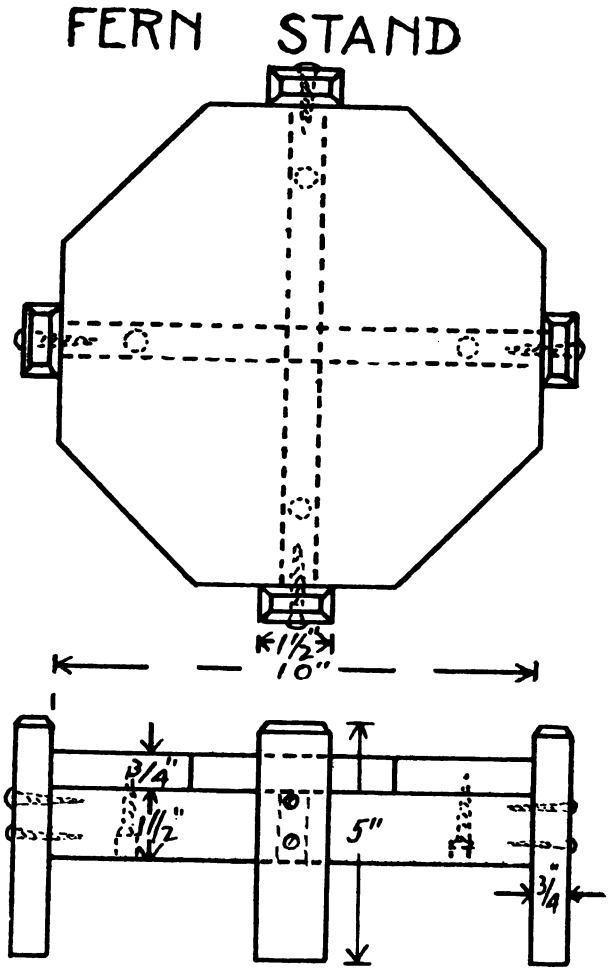
Project. I—Fern Stand.

Drawing: As a preliminary drawing to this plate, pupils should learn to construct a regular octagon by one or more methods. Draw stand to full scale. Insist on accuracy. Place dimension lines with care. Name and date.



Shopwork: Square all pieces. Lay out octagon for top. Chamfer legs with spokeshave, being careful not to break corners. Fasten legs to cross pieces with round-head screws. Finish with stain and wax. Explain method of filing and setting a saw.

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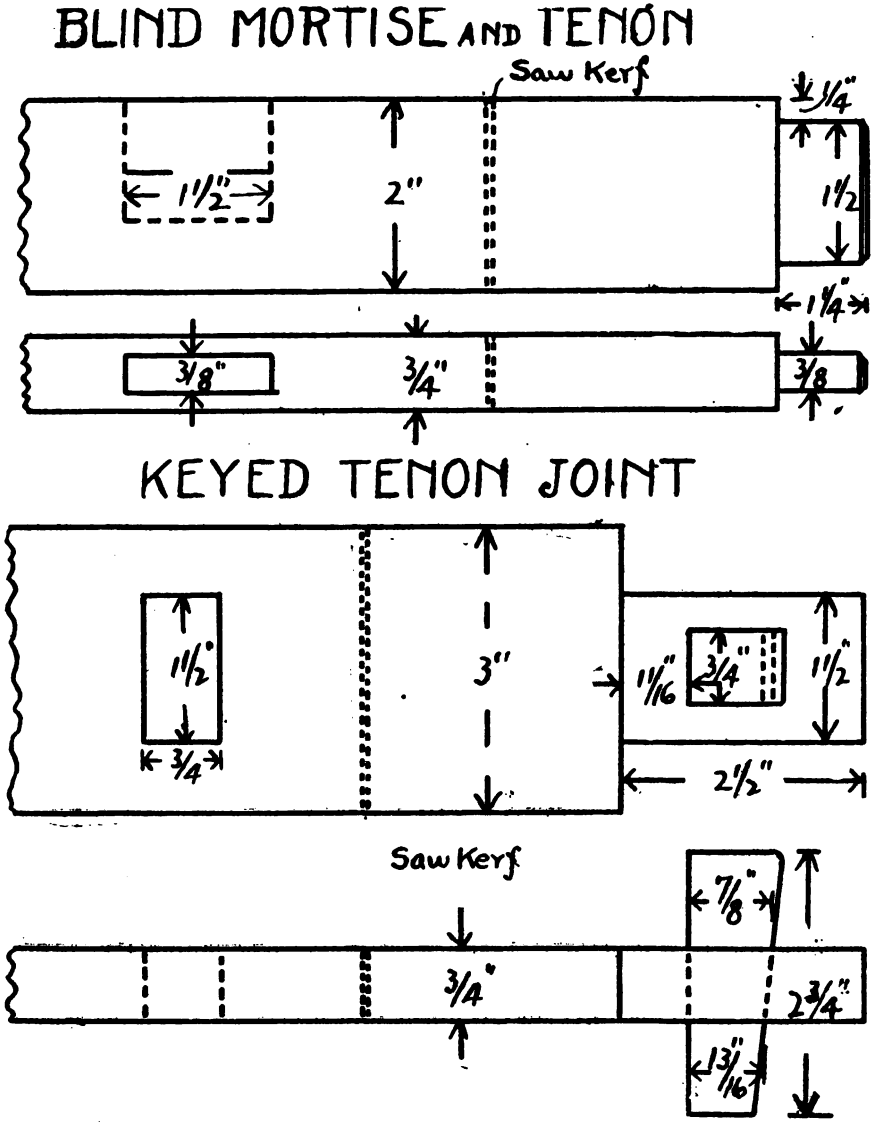
Project II—Mortise and Tenon Joint.

Drawing: Explain that the pieces for joints are made in one piece. When finished, each is cut at line indicated, and the test is to find whether the parts fit as they should. Work out dimensions of key for keyed tenon joint with care. Finish drawing with name and date.



Shopwork: Square pieces as indicated under drawing. Make whole joint in one piece, planning parts that are to fit. Cut on lines shown, and see how well the parts come together. Notice that in the case of the keyed tenon joint, the mortise for key must be so placed that key will draw pieces close together. Show method of sharpening plane

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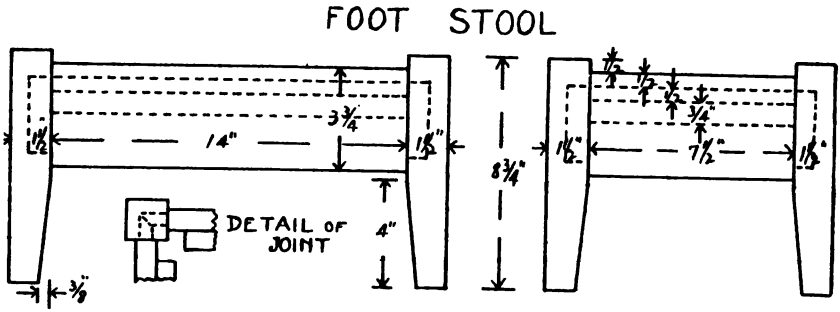
Project III—Footstool.

Drawing: Draw to half-scale. See that all dotted lines are understood. Another plate may be added by throwing these views into an isometric drawing.



Shopwork: Square all pieces. Cut tenons first. Measure carefully and then cut mortises. Notice detail of joint, showing how tenons join. See that all pieces are carefully finished before putting together.

Describe the growth of trees, function of roots, leaves, bark, etc.

Project IV—Wall Shelves.

Drawing: Draw to half-scale. Work out dimensions of keys with care. When completed, pupils may make an additional plate in an oblique or isometric drawing.

Shopwork: Work out dimensions of all pieces. Square each. See that mortise for key is cut sufficiently close so that a good, tight joint is made. Continue talks on deciduous and evergreen trees; hard and soft woods; trees of California that illustrate the points made.

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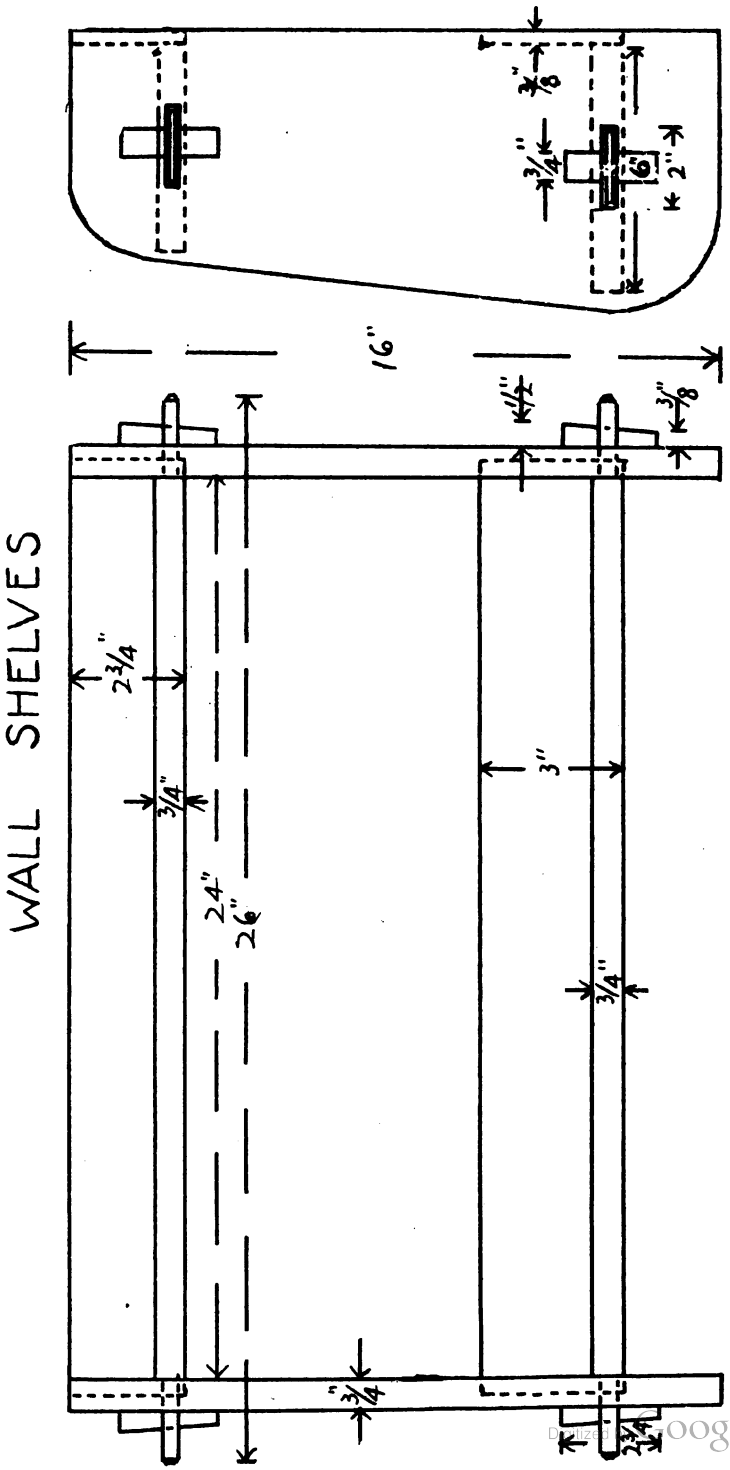

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Project V—Table.

Drawing: Draw to quarter-scale. Make finished drawing. Begin the study of free-hand perspective; illustrate station point, vanishing points, horizon line, parallel and angular perspective. Apply to objects of room, such as boxes, tables, etc.

Shopwork: Work out dimensions of all pieces. Square each. Taper legs on inside. Top is made of two pieces glued together. Study forest distribution of United States.

Project VI—Supplementary.

Continue work in free-hand perspective. Several lessons may be devoted to outdoor work, drawing barns, houses, etc. After some skill is developed in this part of the work, corners of rooms may be attempted, placing a few pieces of simple furniture, fire place, rugs, etc. With crayolas or water colors, walls, floors, etc., may be colored in conformity with the principles of harmony of color.

The supplementary projects included in this bulletin may be divided into two classes: the camp stool, fly trap and the trestle being the more simple, and the fruit picking ladder and tool chest the more advanced. These will serve as types of work that are deemed suitable for pupils who have had the preliminary course as outlined. A drawing should be made of any problem selected, and all pieces should be estimated carefully before the material is cut for use.

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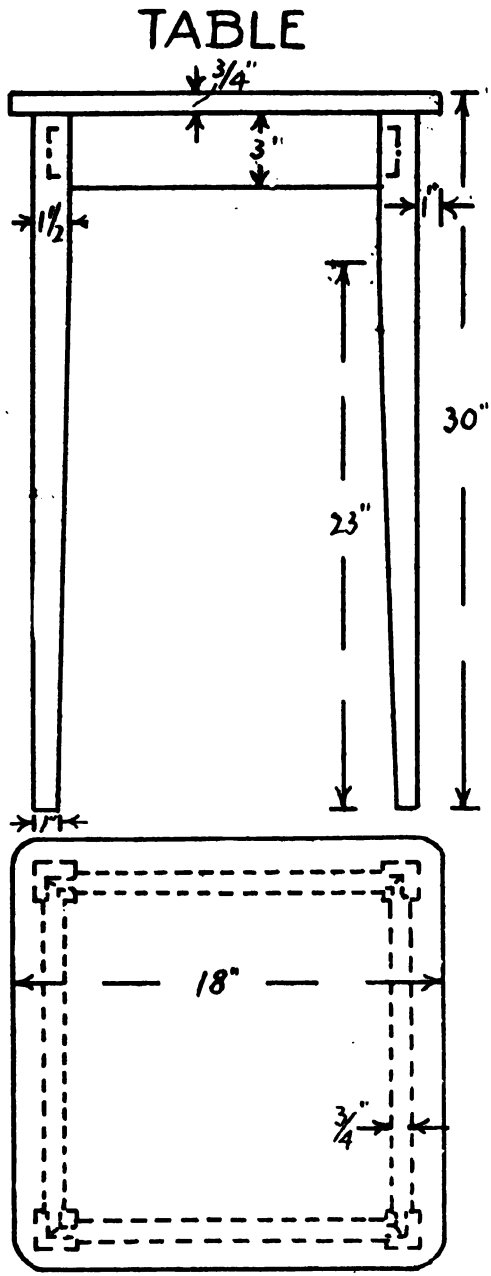

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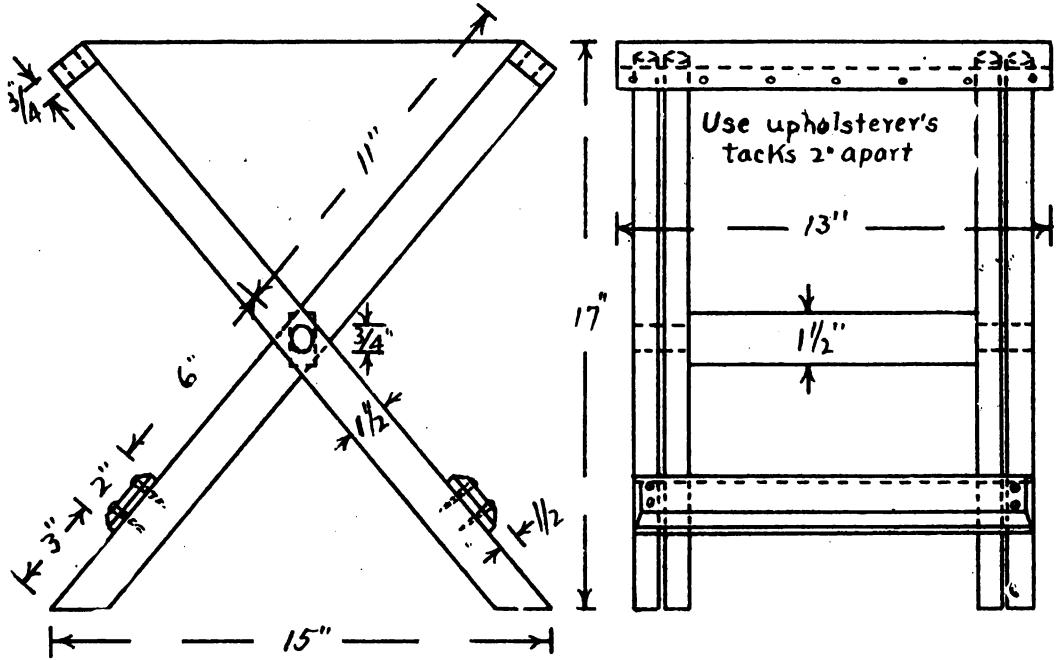
CAMP STOOL



USE CANVAS, DUCK, CARPET OR HEAVY CLOTH FOR SEAT

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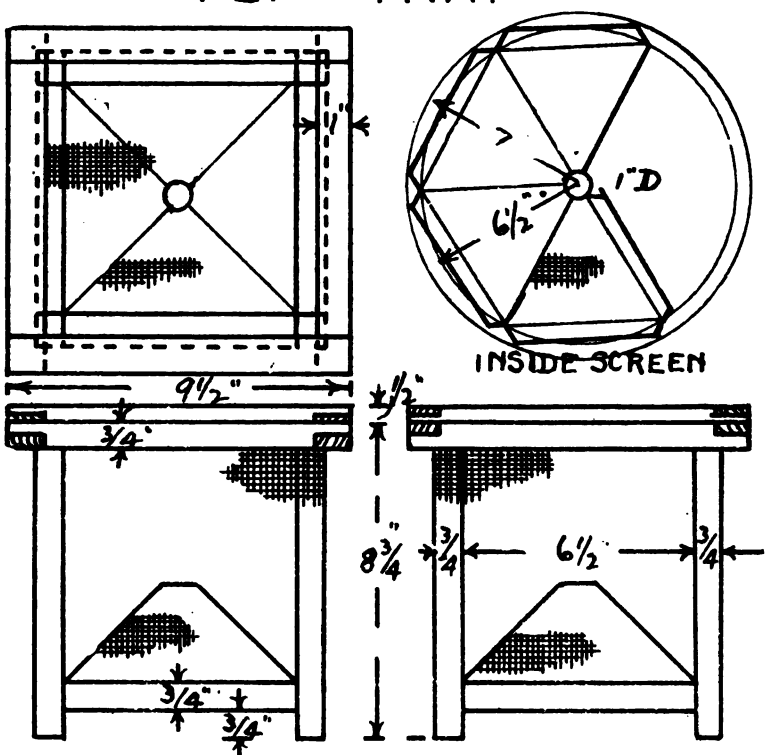
FLY TRAP



MAKE TWO UPPER FRAMES WITH HALF-LAP JOINTS. FASTEN TOGETHER WITH SCREWS OR HOOKS SOTHAT TOP MAY BE EASILY REMOVED

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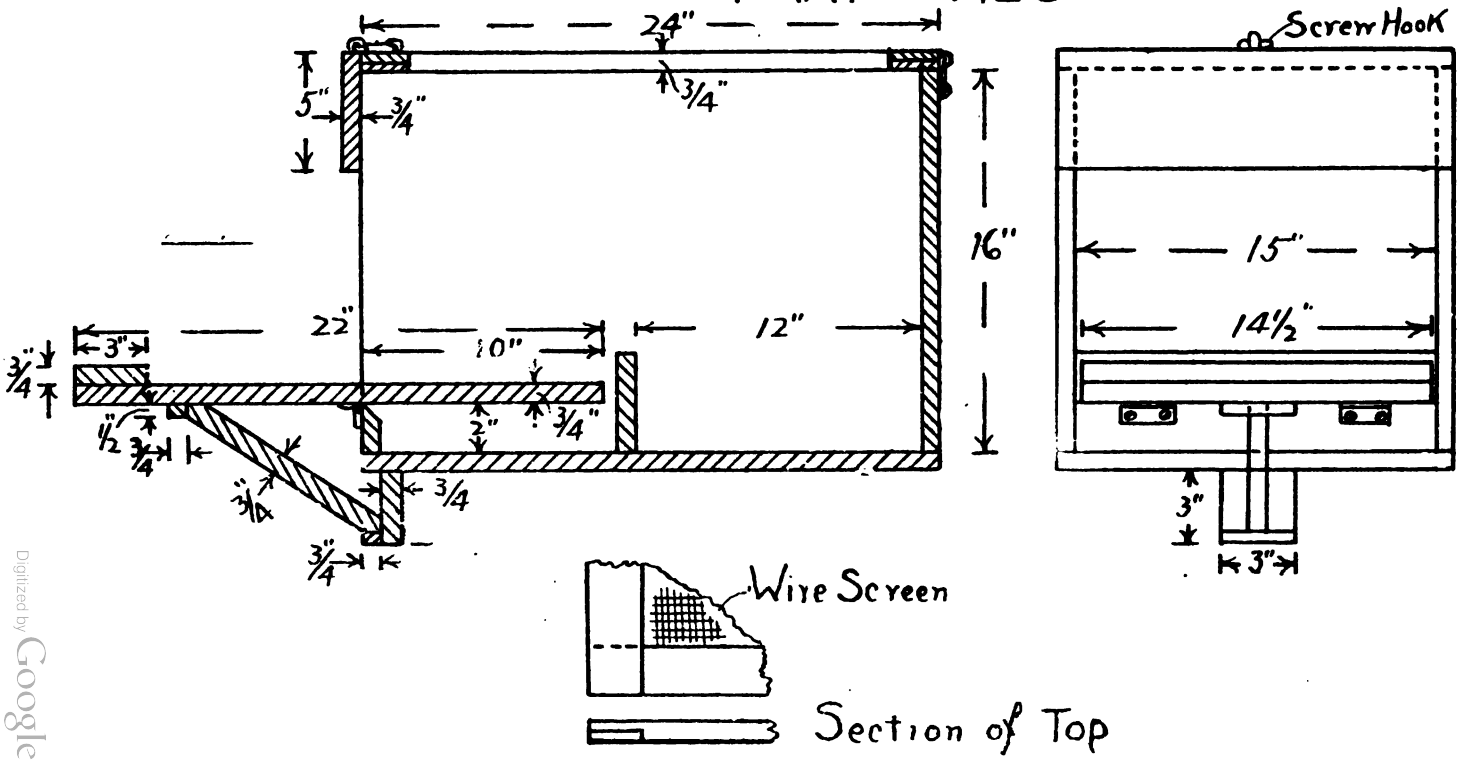
TRAP NEST



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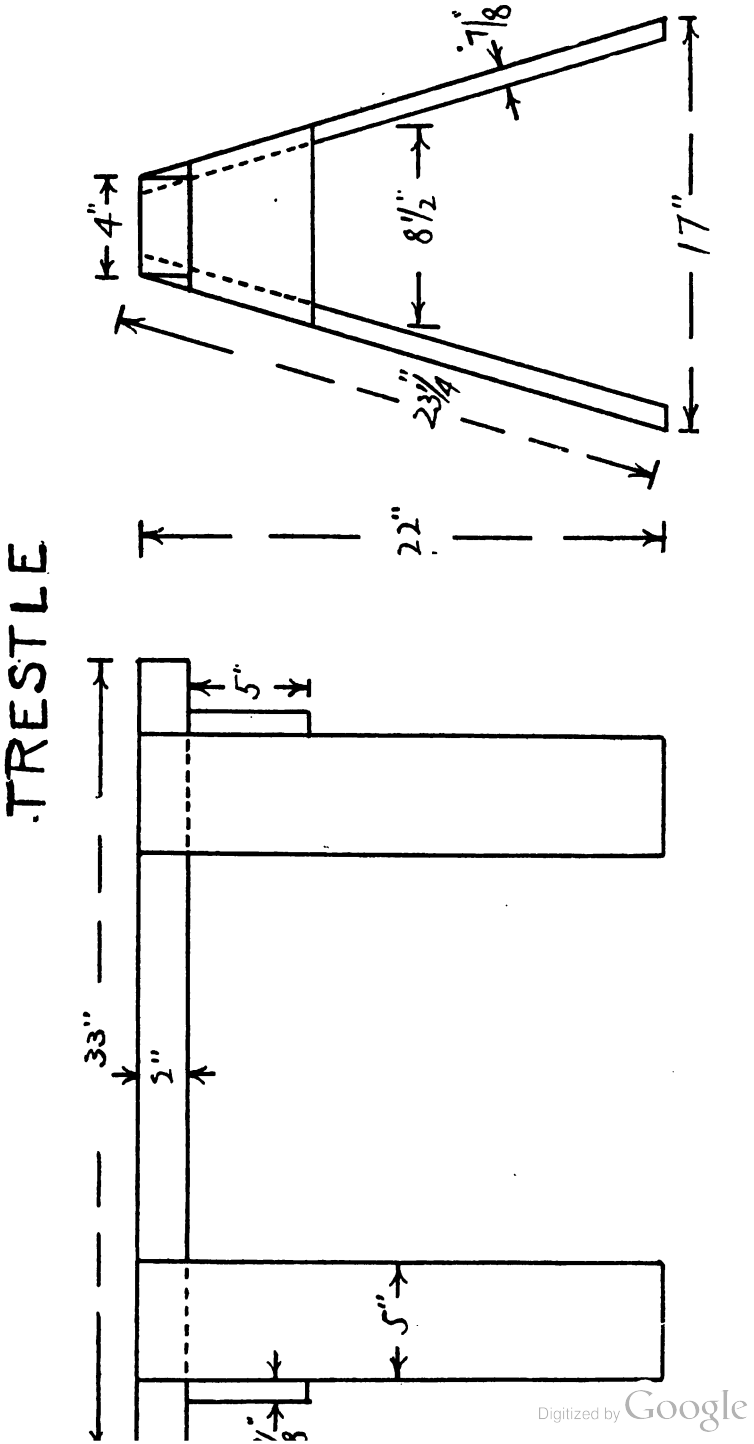

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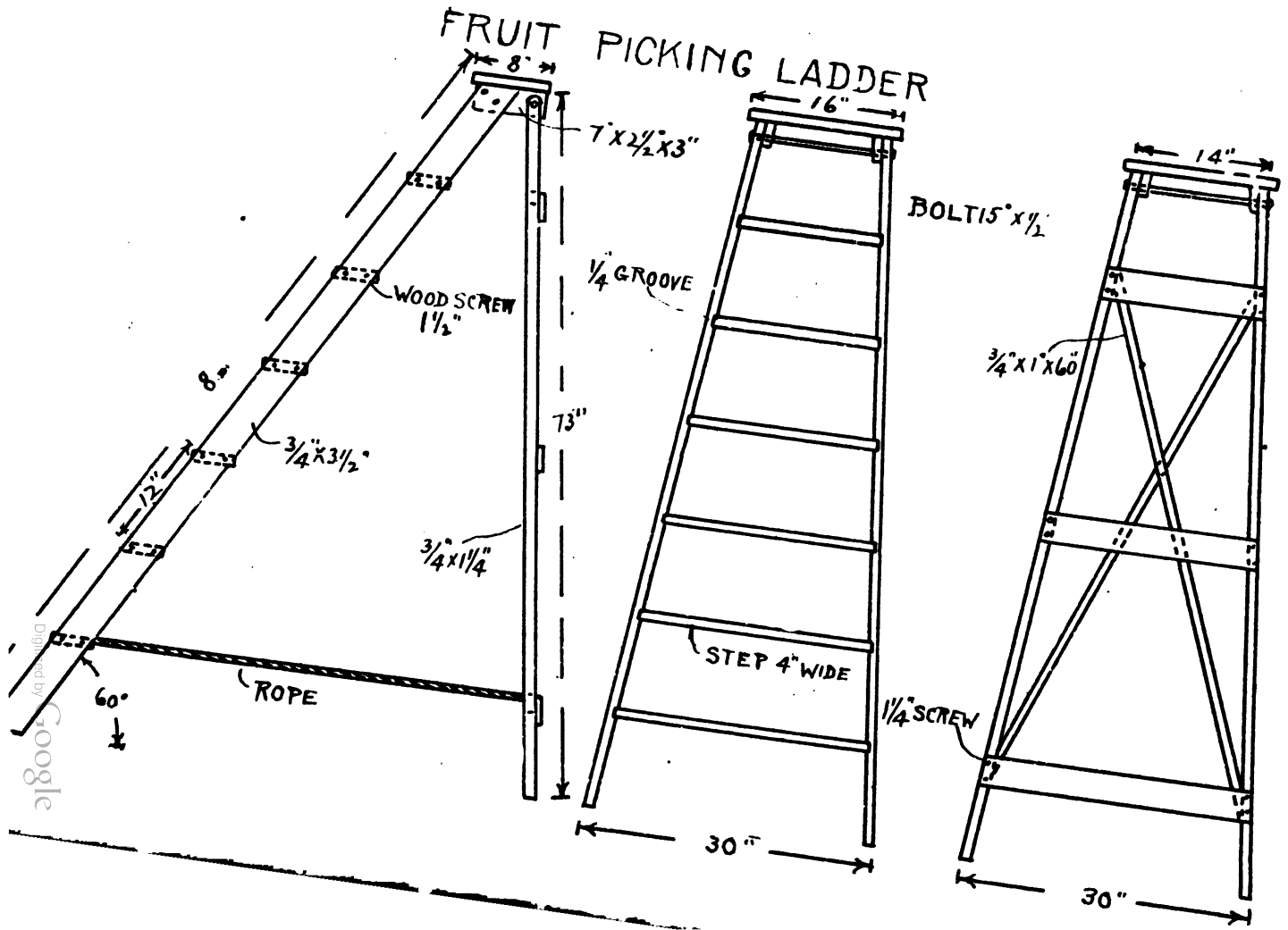

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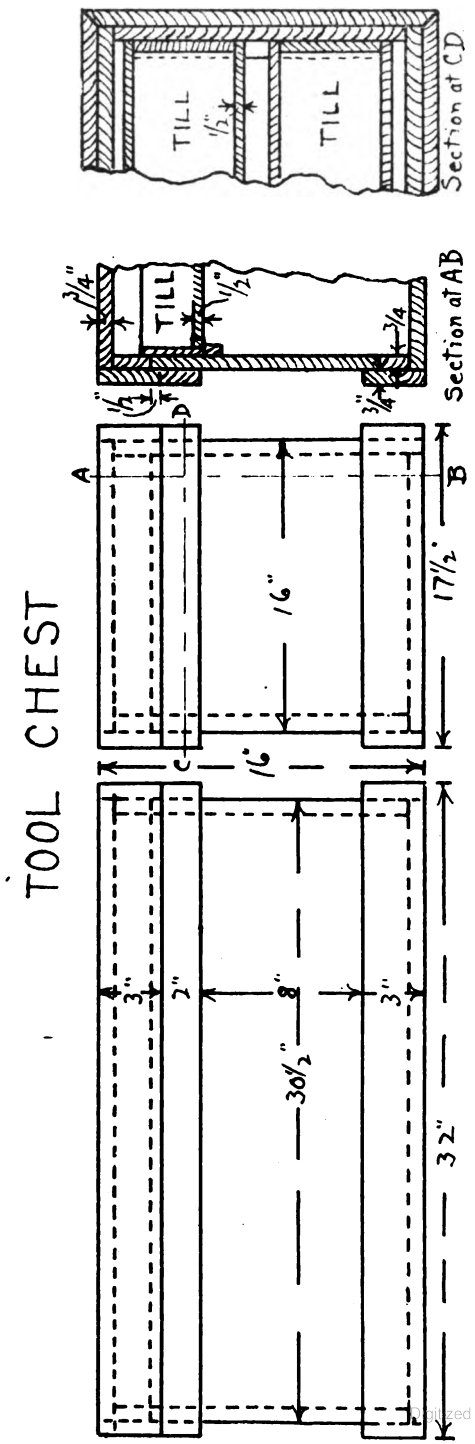

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FRESNO STATE NORMAL SCHOOL

BULLETIN No. 5

Home Economics

IN

Rural Schools

FRESNO, CALIFORNIA
APRIL, 1917

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO
1917

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FRESNO STATE NORMAL SCHOOL

BULLETIN No. 5

HOME ECONOMICS

IN

RURAL SCHOOLS

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SACRAMENTO
1917

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INTRODUCTION.

Realizing the necessity and demand for the introduction of the teaching of home economics in some form in rural schools, this outline is offered as a suggestion of the possibilities of introducing such work.

This is only a tentative outline and must be supplemented with original work as the conditions demand.

The assumption is that the teachers using this outline have had previous training in home economics in their normal school course covering the work suggested.

This bulletin is published in two parts; Part I, covering the work in household science, and Part II, household art. At the close of the bulletin will be found a list of various kinds of equipment, as well as reference books and pamphlets covering both phases of home economics teaching.

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PART I.

COURSE OF STUDY IN DOMESTIC SCIENCE IN THE RURAL SCHOOLS.

Purpose of Teaching Domestic Science.

The purpose of teaching cooking in the schools is to present the underlying food principles in order to insure intelligent selection, preparation, and cooking of foods; to emphasize sanitation as a means of maintaining the health of the family and community; to teach the planning and service of inexpensive simple meals; to teach the value of economy and efficiency and to create such interest in the subject that the girls can be of real help in their homes.

These lessons are planned with equipment not exceeding ten dollars, including a one-burner oil stove, without an oven.

The Kitchen.

The kitchen should be the most sanitary place in the house—well lighted and ventilated. Order, neatness, and cleanliness are requisites.

Every precaution in regard to sanitation must be observed, that the health of the household may be safeguarded.

Personal Habits in the Kitchen.

White aprons and, if possible, wash dresses should be worn.

The hair should be neatly arranged.

Before beginning to cook, the hands should be washed, and the process should be repeated after handling the hair or handkerchief.

Clean cooking means clean tasting. Never put the spoon back into the food after tasting it.

The habit of having clean finger nails can be established as well as that of having neat and clean clothes.

Towels and dish cloths should be hung up at pupils' desks during the lesson when not in use.

Sanitary Care of Food.

Wash eggs, milk bottles, fruit, and meat before using.

Keep in a refrigerator or cooler or other clean place, milk, butter, cream, left over food—tightly covered.

Care needs to be taken to clean thoroughly kitchen cabinets and refrigerator. Daily inspection of food prevents waste and spoiling of food.

A flyless kitchen is essential if food is cared for in a sanitary way.

Dish Washing.

To insure clean dish washing, plenty of hot soapy water and hot rinsing water are essential. Scrape food from dishes and rinse cups before washing them. Rinse or soak in cold water utensils in which there has been egg, milk, or starchy foods.

Thorough washing and scalding of dish cloths and towels, and if possible hanging them to dry in the sun, need be emphasized.

Glass, silver, china, and cooking utensils, is the order in which dish washing should proceed.

Scrubbing brushes and cleaning powders facilitate cleaning of pans and tops of cooking tables.

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Measurements.

All measurements should be level. Dry materials like sugar, baking powder, and soda are leveled off with a knife.

Half a spoonful is obtained by dividing through the middle of the spoon lengthwise; a quarter by dividing a half spoon crosswise.

A cupful of flour means a cup after sifting.

Much depends upon accurate measurements.

References for Bulletins.

Sanitation—Ohio State Univ., Columbus, Ohio.
Cornell Reading Course—Household Bacteriology.
Farmers Bulletins:

No. 43—Sewage Disposal on the Farm.
No. 342—A Model Kitchen.
No. 375—Care of Food in Home.

Abbreviations.

tsp.	= teaspoon	oz.	= ounce
tbs.	= tablespoon	lb.	= pound
c.	= cup	min.	= minute
pt.	= pint	hr.	= hour
qt.	= quart	f. g.	= few grains
gal.	= gallon	spk.	= speck

Table of Equivalents.

Measures.	Weights.
3 tsp. = 1 tbs.	2 c. liquid = 1 lb.
4 tbs. = ¼ c.	4 c. flour = 1 lb.
2 gills = 1 c.	2 c. solid fat = 1 lb.
2 c. = 1 pt.	2 c. sugar = 1 lb.
2 pts. = 1 qt.	3 c. meal = 1 lb.
4 qts. = 1 gal.	2 c. meat = 1 lb.
2 tbs. = 1 oz. sugar	2 tbs. butter = 1 oz.
2 tbs. = 1 oz. liquid	4 tbs. flour = 1 oz.

Five Foodstuffs.

	Use in body	Typical foods
Protein	Serves as building material for tissues of body. Gives heat.	Meat, milk, eggs, cheese, nuts, legumes.
Fats	Furnish heat and energy in a concentrated form.	Butter, olive oil, lard and its substitutes, oil of nuts.
Carbohydrates	Furnish heat and energy in a more economical form.	Fruits, grains, starchy vegetables.
Mineral matter	Builds bone and tissue. Aids digestion. Helps regulate body processes.	Fresh meats and fruits. Green vegetables.
Water	Regulates body processes. Aids digestion. Constitutes about two-thirds of body weight.	Beverages, vegetables, fruits.

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Questions.

What is food?
Which is the more important function of protein, furnishing heat and energy, or building body tissue?
Explain why dried beans can be classified under two important foodstuffs?
How much water should be drunk every day?
List foods that are an excellent substitute for an iron tonic.
Of meat and carbohydrates, which is the cheaper form of furnishing heat and energy?
What are substitutes for potatoes?
Why are baked potatoes, beef loaf, and baked beans a bad combination?
What foods are more appropriate in winter than in summer?
Explain why fresh fruit is of value in the diet?
Under what class of foodstuffs does molasses come?
Give reasons why a knowledge of foodstuffs helps in the cooking and planning of meals.
What are considered meat substitutes?

Reasons for Cooking Foods.

To make food more digestible.
To make it more palatable.
To develop the flavor.
To destroy harmful bacteria.

References.

Farmers Bulletins:

142—Principles of Nutrition and Nutritive Values of Food.
28—Composition of American Food Materials.

Food Preservation.

Methods of destroying microörganisms are low temperature, drying, high temperature, and use of certain preservatives.

Drying is a practical method in the home. Some vegetables, fruits, and meats may be so treated.

Preservatives (harmless): sugar, salt, spices and vinegar; (harmful): sulphuric acid, benzoic and salacylic acids, formaldehyde, and boric acid.

High temperature—
Methods:

1. Cooking and putting into sterilized cans and sealing.
2. Steaming in partly sealed cans.
3. Cooking in cans in the oven.
4. Intermittent cooking at 212° F. for three successive days.

In any method used, every precaution is necessary in sterilizing both the material and the utensils used in order that the product may keep.

Jelly Making.

The process of jelly making involves the combining and cooking of the juice of fruit with sugar. The result is a thick mass.

The jelly-making substance is pectin, a carbohydrate constituent of some fruits.

Pectin test: One tbs. unsweetened cooked juice and 1 tbs. 90–95% alcohol. If enough pectin is present to make the fruit suitable for jelly, a gelatinous mass results.

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N. E. Goldthwaite, Department of Household Science, University of Illinois, states in a bulletin based on many experiments the following results:

Sugar	Fruit juice	Result
½	1	Tough and unpleasantly sour.
¾	1	Tender product, but of sufficient stiffness to stand alone.
1	1	Too tender to stand alone, but in taste and texture suitable for jelly cake.
2	1	Impossible, due to overproportion of sugar.

Conclusions—Best results obtained from the proportion of ¾ sugar; 1 fruit juice.

Questions.

What is meant by second and third extractions of jelly?
Is it worth while making these extractions, or is it a waste of material and time?
Is jelly made from these extractions as clear as that from the first extraction?
What is meant by mean boiling in adding sugar to the juice?
Why is thorough sterilization an essential?
Why is a flannel bag better than one made of muslin?

CLASS WORK.

Apple Jelly.

2 c. apples (cut into pieces). 1 c. water.
¾ as much sugar as juice.

Wash apples, remove blossom and stem ends. Cut into quarters.

To the apples add water. Cook till pulp is soft. Mash the mixture and pour into a wet muslin or flannel bag. Suspend over a bowl. Do not squeeze.

Measure juice, return to pan and heat to boiling point and skim. Add three-fourths as much heated sugar as juice. Stir till sugar is dissolved, stirring occasionally till done. Skim during the process. Avoid too high temperature and overcooking.

Tests. When the jelly coats the spoon or falls from spoon in heavy drops, or when the mixture stiffens on a cold saucer when allowed to cool, the jelly is done. The second test is considered the best.

Method of sterilization: Place glasses, lids, and spoons in a pan of cold water and bring to boiling point and boil 10–15 minutes.

Canning and Preserving.

Discussion of fruits and vegetables as to their food value, presence of carbohydrates.

Kinds of vegetables and fruits suitable for canning.

Selection of fresh, firm, underripe rather than overripe material.

Comparison of cost and food value of bought and home-canned product.

Review of principles involved in the process.

CLASS WORK.

Canned Peaches.

4 good-sized peaches. 1½ c. water.
¾ c. sugar.

Scald fruit in boiling water. Plunge into cold water when skin becomes loose. Remove skins and stone. Pack fruit in jars. Pour in hot syrup. Set jar in boiler or rack surrounded by warm water. Cook about 60 mins. Before fastening lid on tight a little hot water may be added to completely fill the jar. Seal.

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References.

Canned Fruits, Preserves and Jellies—United States Bulletin 203.
Canning Vegetables in the Home—United States Bulletin 359.
Canning Peaches on the Farm—United States Bulletin 426.
Evaporation of Apples—United States Bulletin 291.
Strawberries—United States Bulletin 198.
Canning Tomatoes—United States Bulletin 521.
Fruits and Vegetable Canning—Ohio State University, Columbus, Ohio.
Some Principles of Canning—Purdue University, Lafayette, Indiana.
How to Can Fruits and Vegetables—Ladies Home Journal.
A Canning Business in the Home—Cornell Reading Course.
Jelly and Jelly Making—United States Bulletin 388. 5 cents.
Jellies, Jams, Preserves, Pickles—Ohio State University, Columbus, Ohio.
Home Manufacture and Use of Unfermented Grape Juice—United States Bulletin 644.
How to Can Vegetables and Meats—Ladies Home Journal. 15 cents.

Vegetables.

In this group are two divisions—one which comprises the different parts of many plants, as roots, tubers, bulb, stalk, leaves, seeds or flower; and the other those substances manufactured from many plants, as flour, meals, cereals, starch, sugar, molasses, and sirups.

Vegetables—valuable because of their frame work—largely cellulose. Starch is found in cell walls. The more fresh and tender vegetables are the more easily digested and the less fuel they require. The higher the starch content, the greater the nutritive value. Both the amount of mineral matter and bulk furnished help determine their food value.

Cooking processes ranked upon degree of mineral matter and flavor retained:

Baking—all nutritive value retained, *e. g.*, pumpkin, legumes, potatoes, squash.

Stewing—no nutritive value lost, cooking in the least possible amount of water, as peas, carrots, spinach.

Steaming appropriate for fresh vegetables. Nutritive value retained.

Boiling—cooking in large amount of boiling salted water; therefore a wasteful method. Much mineral matter and some starch lost. Because of strong flavor, onions and cabbage may be so cooked.

To best retain flavor of vegetables choose a method that promotes this feature; serve with butter, pepper, and salt.

To add variety, sauces may be combined with vegetables. The liquid may be the liquor in which vegetables are cooked. Milk is usually used, however.

WHITE SAUCES.

Flour	Butter	Milk	
1 tbs.	1 tbs.	1 c.	Thin white sauce.
2 tbs.–3 tbs.	1 tbs.	1 c.	Medium white sauce.
3 tbs.–4 tbs.	1 tbs.	1 c.	Thick white sauce.

BOILED POTATOES.

Boil the potatoes. If mineral matter is to be best retained boil potatoes with skins on. If a snow white product is desired, first pare the vegetable. This causes more of mineral matter to be lost.

To insure a mealy potato drain off water in which potatoes boiled. Gently shake pan over the flame to dry out the moisture. The result is a more digestible and palatable potato.

Allow one portion of white sauce to two or three parts of vegetable.

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CLASS WORK.

CREAMED POTATOES.

Cut boiled potatoes into cubes.

WHITE SAUCE.

1 tbs. butter.	f. g. pepper.
1 tbs. flour.	1 c. milk.
½ tsp. salt.	

Combine butter and flour. Add seasoning and milk. Stir frequently. Cook in double boiler or over very low heat directly over the flame. Cook about 15 mins. Combine potatoes and white sauce, using half as much white sauce as potato.

CREAMED POTATOES.

Into a buttered baking dish place alternate layers of raw potatoes, dots of butter, seasoning, and dashes of flour. Pour enough milk over the mixture to barely cover it. Bake about 45 mins. Cheese or buttered bread crumbs may be sprinkled on top before baking the dish.

Questions.

Why dry potatoes over the flame after water has been drained off?
Which is higher in food value, potatoes, or rice? In cost?
How do cereals rank in nutritive value?
In cooking potatoes with what foodstuff are we most concerned?
What is the effect of iodine on starch?
Test cabbage, corn, rice, dried beans, tomatoes, lettuce, carrots, and turnips with iodine. To what conclusions do you come?
Are spaghetti and tomatoes a good combination?
Write lists of vegetables—one list high in starch and the other low in starch. Does this help determine suitable combinations in making menus?
Is amount of starch in potatoes overestimated?
Why are starchy foods best cooked at 212° F. or above?

References.

Preparation of Vegetables for the Table—U. S. Bulletin No. 256.
Potatoes in the Dietary—Cornell Reading Course No. 81.
Potatoes and Other Root Crops—U. S. Bulletin 295.
Beans and Similar Vegetables as Foods—Cornell Reading Course No. 89.
Rice and Rice Cookery—Cornell Reading Course No. 55.
Food Value of Corn and Corn Products—U. S. Bulletin 298.
Beans, Peas, and Other Legumes as Food—U. S. Bulletin 121.

Cereals.

Cereals are manufactured from grains of numerous members of the grass family, *e. g.*, wheat, oats, corn, rice. Because of high per cent of starch they require high temperature and long cooking. Their digestion depends upon manner of cooking.

Cereals are cooked—

1. To sterilize the material.
2. To improve the flavor and appearance.
3. To produce such changes in structure that the digestive juices more readily act upon the nutrients.

Overcooking is unusual and harmless. Cook longer than suggested in directions on the package. Cereals bought in the bulk are cheaper than by the box.

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CLASS WORK.

ROLLED OATS—A FLAKED CEREAL.

4 c. boiling water. 2 c. oats.
1 tsp. salt.

CREAM OF WHEAT—A GRANULAR CEREAL.

4 c. boiling water. 1 c. Cream of Wheat.
1 tsp. salt.

Slowly add cereal to boiling salted water, stirring constantly. Boil till the mixture begins to thicken. Place in double boiler and cook from 45 mins. to 2 hrs.

Serve with cream. Dates, figs, bananas, or other fruit may be served with it. Left over cereal may be fried like mush.

Milk.

The value of milk as food is underestimated. If properly modified it is a perfect food for babies, but because of high per cent of water other foods must be used with milk to furnish sufficient nourishment for adults. For those in poor health no single food is of so much value.

ANALYSIS OF MILK BY EXPERIMENTS.

Experiment 1. Drop milk or cream on a blotter or unvarnished wood. What kind of a spot is made?
Experiment 2. Test with iodine. Is starch present?
Experiment 3. Boil some milk. What forms on top?
Experiment 4. Add an acid. What happens?

AVERAGE COMPOSITION OF MILK.

Proteins (casein, small amount of albumen)	3.3 per cent
Carbohydrates (milk sugar)	5.0 per cent
Fats (cream)	4.0 per cent
Ash constituents	.7 per cent
Water	87.0 per cent

A quart of milk is equivalent to a pound of steak or 8 eggs in food value.

There is no food more easily attacked by bacteria. For this reason the greatest care should be taken in dairies. Stringent laws concerning the care of dairies should be rigidly enforced.

In the home, milk should be kept in a clean, cool place and should never be left uncovered. Since uncooked milk is easier of digestion, milk should not be pasteurized (heated to a temperature of 155° F. for half an hour) unless there is danger of its not being comparatively clean milk. Certified milk is the best, but is too expensive for the average consumer.

CLASS WORK.

RENNET CUSTARD OF JUNKET.

2 c. milk. ½ tunket tablet dissolved in 1 tbs. water.
3 tbs. sugar. 1 tsp. vanilla.

Heat milk till it is lukewarm. Add other ingredients. Stir. Pour into molds. Serve with cream, fruit juice, or stewed fruit.

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Questions.

What is skim milk?
What effect has boiling on milk?
Why is some milk low in fat content?
Is milk good food for children? Why?
Should the scum that forms on scalded milk be removed?
What precautions must be taken in the dairy to make it sanitary?
How can milk become the means of carrying typhoid fever bacteria?
Why do so many babies die before the age of one year? Why is the death rate so much higher in summer than in winter? What safeguards should be taken?
In what ways can the housewife assist in having clean milk on the market?
Is buttermilk an aid to digestion? What are some of the later theories in regard to this point?

References.

Care of Milk and Its Use in the Home—U. S. Bulletin 413.
Bacteria in Milk—U. S. Bulletin 490.

Cocoa and Chocolate.

Study of their source and manufacture. Comparison and contrast of the two as to food value and digestibility, their stimulating effect, and cost.

CLASS WORK.

COCOA.

4 tbs. cocoa or chocolate or 1½ oz. bitter chocolate.
3 tbs. sugar.
1 c. water.
spk. salt.
3 c. hot milk.
½–1 tsp. vanilla.

Combine chocolate or cocoa with sugar. Add water. Cook till smooth, boiling about 3 mins. Add salt and milk. Bring to boiling point. Beat with Dover egg beater before serving. Add vanilla if desired.

Questions.

Why combine cocoa with sugar and water and boil together before adding the milk?
Which of the two is more harmful for children, cocoa or coffee?
Do the foodstuffs in this beverage affect their cooking?
What effect has boiling on milk?
Suggest at least ten different kinds of dishes in which chocolate can be used suggestive of foods to be cooked at home.
In order to correlate the work with composition and language work, compositions can be written on the manufacture of cocoa and chocolate.

References.

Walter Baker & Co.'s free book.

Soups.

Two classes are, soup made with stock and those without stock, such as cream soups.

Cream soups are a combination of white sauce and strained vegetable. A puree is the pulp of a cooked vegetable strained and thinned with milk.

A cream of vegetable soup is a very thin puree. Vegetables commonly used are peas, beans, potatoes, onions, cabbage, celery, rice and tomatoes. This class of soups is nourishing and economical. Because of high food value these soups are better served at a luncheon than at a dinner.

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WHITE SAUCES.

For soups in which starchy vegetables are used, 1 tbs. flour is sufficient to 1 c. milk. If such vegetables as tomato or celery are used, 2 tbs. flour to 1 c. milk are enough.

One part of vegetable pulp to two parts of liquid is a good proportion. A thinner soup may be used.

Crackers, croutons, bread sticks, imperial sticks may be served with soup.

CLASS WORK.

CORN SOUP.

1 can corn.	2 tbs. butter.
1 pt. water.	1 pt. milk.
1 slice onion.	1 tsp salt.
1 tbs. flour.	⅛ tsp. pepper.

Simmer the first three ingredients 15 mins. Put through a colander. Make white sauce with the remaining ingredients.

White Sauce. Combine flour and butter. Add seasoning and milk gradually. Cook in double boiler or at very low temperature, stirring constantly. Combine the two mixtures.

Questions.

Make out two menus in which corn soup may be served.
Why put corn mixture through a colander?
Why does a soup with corn require less flour?
Could liquor used from boiling different vegetables during the few previous days be saved and used in making soups?
Is it good form to break crackers into soup.
Might left over vegetables and meats be added?
Is soup good if reheated? If so, might enough be made to use the next day?

Dried Fruit.

Food value of fruits, ease with which prepared, economy, *e. g.*, dried apples, raisins, apricots, peaches, figs, prunes, all of which are high in food value.

There is more nourishment in dried fruits, at less cost, than in fresh fruits.

PREPARATION OF DRIED FRUITS.

Thoroughly wash. Soak in fresh water, using the same water later in which to cook the fruit. Add sugar when fruit is nearly done.

CLASS WORK.

APRICOT WHIP.

1 c. dried apricots.	3 egg whites.
½ c. sugar.	

Cook fruit as directed above. Put through a colander. Add sugar. Add to stiffly beaten whites of eggs folding in the apricot mixture. Chill before serving or pile lightly in a buttered baking dish and bake in slow oven 20 mins.

Dried prunes may be substituted, using less sugar, and 1 tbs. lemon juice. Fresh fruit may be used. The pudding may be served with soft custard.

SOFT CUSTARD.

1½ c. milk.	3 tbs. sugar.
3 egg yolks.	f. dps. vanilla.
spk. salt.	

Beat yolks till lemon colored. Add dry ingredients. Add milk gradually. Cook in double boiler over very low heat. When the mixture coats the spoon it is done. Strain and add vanilla and chill.

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Questions.

Why soak dried fruit?
Why use this same water in cooking the fruit?
Is it better to add sugar at the beginning of the process of cooking the fruit, or toward the last? Explain.
Make a list of dishes in which stewed fruit can be used.
What fruits can be profitably dried on the farm?
What are the keeping qualities of dried fruit?
What is the advantage of adding custard?
Does the white of egg add much food value?
With this kind of a dessert does one need a nourishing meal or the reverse?
Why is it necessary to cook custard at low temperature?
What two causes give rise to curdling?

BLANC MANGE.

¼ c. sugar.	f. g. salt.
¼ c. cornstarch.	2 c. scalded milk.

Combine dry ingredients. Add milk slowly. Cook mixture from 20 to 30 mins. in double boiler. Add vanilla. Pour into wet molds. Fresh and dried fruit may be combined to add variety and food value.

Questions.

What is the advantage of first combining sugar and cornstarch? In what other recipes was a similar combination made?
Is this an expensive dessert?
Is it nourishing?
Might a small amount be made to combine with left-over fruits?

References.

Use of Fruit as Food—U. S. Bulletin 293.

Fish.

Dried fish is high in food value and comparatively inexpensive. It is in a form that can be kept well and is easily prepared.

CLASS WORK.

CODFISH BALLS.

1 c. codfish.	salt if needed.
1 c. potatoes cut into cubes.	flour for dredging.
1 egg.	

Pick codfish into pieces and soak in lukewarm water, the time depending upon the hardness of the fish. Combine fish, after it has been shredded, with the potatoes, cover with water and cook till the potatoes are tender. Drain well. Dry over heat. Mash and heat mixture in saucepan and add egg. Taste to see if salt is needed.

Shape into round flat cakes about an inch thick, dredge with flour. Saute in very little fat or fry in deep fat. If the latter method is used, the grease should be hot enough to brown a cube of bread in 40 seconds.

References.

Fish as Food—U. S. Bulletin 85.

Eggs.

Study of protein foods is important because of value in diet and their high cost.

Development of fact that high temperature toughens protein while low or moderate temperatures produce a more tender and more digestible as well as more palatable product.

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CLASS WORK.

POACHED EGGS.

Into boiling salted water drop the eggs. Reduce temperature. Cover and allow the eggs to cook below boiling point. Let cook about 5 mins. until a film covers the yolk. Remove from the pan, drain and serve on buttered toast.

SCRAMBLED EGGS.

4 eggs.
1 tsp. salt.
spk. pepper.
½ c. milk.
1 tbs. butter.

Combine eggs slightly beaten, milk and seasoning. Pour into a frying pan in which the butter has been melted. Stir gently. Keep the heat low. Do not allow the mixture to cook too long.

EGGS A LA GOLDENROD.

3 hard cooked eggs.
1 c. 1:1 white sauce.

Combine white sauce according to previous recipe. Chop the whites of eggs and combine with the sauce. Pour over the toast. Put yolks through a strainer and sprinkle over the top of mixture.

SOFT AND HARD COOKED EGGS.

Put eggs into boiling water. Reduce the heat. If soft cooked eggs are desired, simmer eggs 4 to 6 mins. If hard cooked eggs are wanted, simmer them 30 mins.

Questions.

Why should eggs be washed when brought into the kitchen?
What other foodstuffs have we cooked that should not be boiled?
How can simmering and boiling points be distinguished?
What difference can be detected between hard boiled and hard cooked eggs?
Knowing the foodstuff that is lacking in eggs, name five foods that would supply that special foodstuff that is low?
Are raw eggs easily digested?
Does cooking increase or decrease the digestibility of proteins?
Why do we cook proteins?
Write ten egg dishes that can be used as meat substitutes.

References.

Eggs and Their Uses—U. S. Bulletin 128.

Meat.

Discussion of food value, cost, structure of meat—importance as food.
Classification of meat in the market—beef, veal, mutton, lamb, and pork.
Examination of pictures or charts of meat cuts in order to determine which are the tender and which the cheaper cuts according to whether or not the muscles of the particular parts of the animal were used little or much.
Experiments showing effect of cold and hot water, searing and salt on meat.
Meat is flesh of animals used for food.

1. Domestic animals.
2. Game.
3. Poultry.

Beef is the most nutritious meat; mutton ranks next; pork next, but difficult to digest; lamb is tender but not so tender as mutton; veal is least nutritious and is difficult to digest; it is liked for its flavor and to give variety.

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Good meat is firm, elastic and bright, uniform in color when first cut; the fat is firm, and light straw color or a pale yellow. Lean meat is muscle. Much used muscle absorbs food material, making rich, juicy meat, but not always of tender fiber.

CLASS WORK.

SWISS STEAK.

Pound flour, salt, and pepper into a round steak. Sear on both sides till brown, using as little grease as possible in the skillet. Cover partly with water and simmer from 1 to 3 hrs., depending upon the thickness of the meat. Make gravy. Serve on hot platter.

Questions.

What effect have salt and cold water on meat?
Is it a good plan to soak soup meat in cold salted water? Why?
What effect has searing on meat? Give four illustrations where you could recommend searing.
Will meat brown in water?
Should meat be boiled? If not, what temperature do you suggest?
Why not add a large amount of water to Swiss steak in cooking it?
Does searing mean merely searing as suggested above, or can meat be seared by coming in contact with hot water?
Why can a porterhouse steak or rib roast be cooked at a higher temperature than a piece of soup bone?
What is the average per cent of protein in meat?
Is it sufficient to eat meat but once a day?
Name as many meat substitutes as you can.
For what reason is meat cooked?
Why is scraped meat given to invalids?
Is the same foodstuff that is low in eggs lacking in meat?
Why is vinegar added to tough meat?

References.

Meat on the Farm. Butchering, Curing and Keeping—U. S. Bulletin 183.
Meat Composition and Cooking—U. S. Bulletin 34.

Spaghetti.

Manufacture of spaghetti and macaroni, vermicelli and other Italian pastes.

Flour made into a stiff paste with hot water, then placed in an iron cylinder, the end of which is closed by a disk pierced with holes. A piston forces the paste through these threads, rods, or tubes according to the shape of the opening. When dry the threads form vermicelli; the rods spaghetti, and the tubes, macaroni. Italian macaroni is dried by hanging over wooden rods in the open air or in ovens; American macaroni is laid on flat frames.

These pastes are made from glutinous flour or hard wheat. Because of the large amount of gluten they afford an excellent meat substitute when combined with milk and cheese.

CLASS WORK.

SPAGHETTI AND CHEESE.

¾ c. spaghetti, broken into 1-inch pieces.
2 qts. boiling water.
1 tbs. salt.
1½ c. white sauce.
¼ to ½ c. grated cheese.

Cook the spaghetti in boiling salted water till nearly cooked. Drain and rinse with cold water. Alternate layers of spaghetti, cheese and white sauce laid in a buttered baking dish. Rice or macaroni may be substituted. Bake about 20 mins.

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SPAGHETTI AND TOMATO SAUCE.

½ box spaghetti.
2 qts. boiling water.
1 tbs. salt.

Cook spaghetti in the boiling salted water till done.

TOMATO SAUCE.

2 tbs. butter.
2 tbs. flour.
1½ c. strained tomato.
½ tbs. salt.
f. g. salt.

Combine butter and flour and seasoning and stir until thoroughly blended. Pour on gradually the tomato liquor. Cook till the mixture is smooth and thick.

References.

Cheese Making on the Farm—U. S. Bulletin 166.

School Lunch Box.

No lesson is of more vital interest to the parents, as well as the class, as that on the lunch box.

Receptacles in which to carry the lunch: The pasteboard box is least desirable; the tin pail sanitary because it can be scalded after using, but objectionable because so tightly covered that the flavors of food become more or less mingled; the covered basket, because of its affording better circulation of air, seems to have the advantage over the pail. The disadvantage, however, is that the food dries out a little more.

Paper napkins are inexpensive if bought in large quantities. They add a fresh appearance to the lunch box. They can be changed every day and so simplify the question of laundering linen ones.

The food should be appetizing, wholesome, plain, and easily digested. The attractiveness is a strong feature because, at best, cold lunches are not ideal, and thermos bottles are not practical, because of the expense. Variety is important.

That the lunch may be one that meets the food requirements, a knowledge of the foodstuffs is necessary.

The amount of lunch prepared will depend upon the one for whom it is packed. The amount of food and the thickness of the slices of bread will be determined also by the above consideration. Usually boys require more food than girls.

In making sandwiches it is easier to spread melted butter on the bread before cutting the slice. A sandwich is more dainty with the crust removed, but the crust is of high food value.

Filling for sandwiches. Meat can be sliced or ground well, and seasoned or combined with cream or salad dressing. Chopped olives and celery are good and furnish variety, combined with ground meat or nuts with dressing.

Sweet sandwiches. Fruit with or without nuts—moistened and spread on bread is high in food value and good. Various kinds of bread as whole wheat, brown, graham bread, or oatmeal and graham crackers can be used.

Cheese, peanut butter, jelly, egg, crisp pieces of bacon, or even plain bread and butter sandwiches are acceptable.

A piece of cake, small glass of marmalade, a few cookies, a hard cooked egg, crisp pieces of celery, a mold of blanc mange, custard, or some plain dessert, add variety.

Emphasis should be placed on the neatness and attractiveness of the arrangement of the food. Paraffin paper is a valuable addition when used.

Fresh fruit is always acceptable. Sections of orange wrapped in paraffin paper, a few nuts, a cup cake, a glass of fruit whip, are merely suggestive of numerous relishing dishes.

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CLASS WORK.

Making of sandwiches in class.

Home work may be given credit in this kind of lesson by having the girls bring their lunches for the teacher's inspection to see if the pupils understand the suggestions. Interest will be roused, and too, this is an excellent opportunity for bringing to class samples of the girls' cooking.

Care of Left Overs.

In general it is poor economy to have left overs. Time and energy of the housewife and extra food are required in order to manage to use left overs to advantage. It is best to so manage that the food cooked is used at the particular meal for which it was planned.

However, food is occasionally left and should never be thrown out. Soups and salads and "made over dishes" furnish means of using up food.

Pieces of toast can be reheated or broken into bits and used as croutons. Pieces of butter from the dinner plates can be used for cooking. Soup stock, vegetables, liquor in which vegetables were cooked, and gravy, can be used as foundation for soup. Bits of meat, rice, and potatoes can be utilized in croquettes, meat balls and hash.

CLASS WORK.

HOT POT.

Into a greased baking dish place a layer of mashed potatoes, a layer of ground meat, and another layer of potatoes combined with an egg yolk. Season highly. Moisten well with milk or meat stock. Bake about 20 mins.

Candy.

FONDANT.

Materials.	Utensils.
2 c. sugar.	Saucepan.
½ c. hot water.	Measuring cup.
	Tablespoon.
	Knife.

Procedure.

1. Combine sugar and water and stir until the sugar is dissolved.
2. Place the pan over the heat, stirring until the boiling point is reached.
3. Place lid on the pan in order to retain the steam. This prevents crystals from forming on the sides of the pan.
4. Boil the candy to the "soft ball" stage.
5. Remove pan from the heat.
6. Cool until the mixture is cool enough that the hand may be held comfortably on the bottom of the pan, or a wrinkled surface appears on the candy, or the candy is cool enough that the finger may be inserted.
7. Beat the candy till it is white and the gloss is lost. Do not allow it to become too crumbly.
8. Remove from pan and knead till candy is of creamy consistency and can be molded.
9. Place in a jar with a damp cloth drawn tightly over the top of the jar. Leave at least twenty-four hours before trying to mold it.

References.

Principles of Candy Making—University of Missouri, Columbia, Mo.

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Steaming.

Its value was discussed in connection with the steaming of vegetables. In the making of puddings the process is used to furnish a slightly different method of cooking and to give variety.

CLASS WORK.

CHAMELION PUDDING.

Cover the bottom of a baking dish with biscuit dough half an inch thick. Fill the pan nearly full of fruit. Cover with a layer of dough.

1½ c. flour.	4 tbs. shortening.
¼ tsp. salt.	½–¾ c. milk.
3 tsp. baking powder.	

Biscuit Dough. Sift dry ingredients. Cut in shortening. Add milk gradually to make a soft dough.

Dried fruits, as apples, peaches or apricots, are good. Canned cherries are excellent.

Table Service.

Good taste demands simplicity, which is the keynote of table service. Wholesome, well-cooked food, if attractively arranged, promotes a feeling of comfort and happiness. China, silver, and linen need not be expensive, but the pattern can be neat. Cleanliness and order in the dining room are necessary.

Menu Making.

Consider the needs of the family.
Consider cost and nutritive value of the food.
Plan to have meals of proper food values.
Select food in season.
Have variety and contrast.
Avoid having indigestible food.
Plan to conserve housewife's time and energy in cooking and serving of meals.
Plan so that there will be no left overs.
Do not have too many foods cooked. A few well chosen ones are best.

Table Customs.

Consideration of the rights and feelings of others.

Refraining from comments or complaints about the food and discussion of unpleasant subjects while eating.

Teaching the accepted manner of using knife, fork, spoon, glass, and cup.

Customs of Eating.

Taking small mouthfuls.
Swallowing liquids and soups quietly.
Refraining from talking with food in the mouth.
Chewing with mouth closed.
Breaking slices of bread into smaller pieces before spreading on the butter.
Avoid reaching across the table.
Eating from the side of the spoon.

The day of the lesson in table service each girl can bring from home her own china, silver, napkin, and a glass. The lesson can be very satisfactorily carried on in this way without necessitating the buying of such equipment.

Equipment.

Suggestions in the way of equipment and reference books will be found at the close of this booklet.

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PART II.

SEWING.

A Suggestive Outline for Instruction in Sewing in the Four Upper Grades of the Rural School.

This subject will necessarily be taught by the regular grade teacher who will have had some training in the Household Arts.

The success of the work depends largely upon the willingness and enthusiasm of the teacher. She must realize that its purpose is not only to develop good technic, but also to teach the future home makers how to do their work intelligently, efficiently, and with interest. High ideals and habits of wise expenditure should be developed. The teacher herself is an example in personal appearance. She must keep her supplies in good order and make provision for the care of the pupils' equipment.

The instruction consists in each grade, of the making of a series of articles, selected according to the ability of the pupils and arranged in sequence so that each project contains at least one new problem and a review of one or more of those already learned. With the making of each article opportunity is given for important instruction in economy, hygiene, and many other matters of educational value. The work in sewing should be related whenever possible with other studies, such as arithmetic, geography, history, and grammar. Practical use is made of arithmetic in taking measurements and in estimating amounts of material. Problems related to sewing should be given in the arithmetic class. The growth and manufacture of the textile fibers should be considered when the countries concerned are being studied in geography. Textiles and articles used in sewing are excellent topics for compositions.

Textile study is very important in connection with instruction in sewing and should be given as an integral part of the lessons. The study of the growth and manufacture of textiles has not only cultural value, but also develops an interest in all phases of modern industry. The fabric itself and its selection should be considered with especial emphasis in the seventh and eighth grades. The pupils should be encouraged to purchase materials for the articles made because of practice in the simple business transaction and in judging fabrics. Textile work is made vital by ample illustration. The raw materials may be grown at school and samples of raw materials, the fabrics, and pictures of all sorts should be used as illustrative material.

Class instruction should be adhered to as much as possible to economize time and because it is of greater educational value. The

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recitation period should be short enough to hold the interest of the pupils and to allow time for application of the instruction. The teacher's work is not finished when the lesson has been presented. The success of the finished product depends upon careful supervision of the work as the children sew. The instruction for the day should cover the steps to be accomplished during the period. If a portion of the class completes this work, the group may be taken aside and given additional instruction. If the remaining few are not too far behind the others, it may be advisable to call the attention of the entire class to the lesson. If the recitation has been successful, the pupils will be able to apply it with little help from the teacher. They should work independent of the teacher with her careful supervision. In order to make a lasting impression upon the minds of the pupils each step must be frequently reviewed. Explanations should be carefully illustrated by demonstrating and by drawings and diagrams. An abundance of illustrative material is necessary in the form of pictures, samples of fabrics, samples of stitches, seams and processes, finished articles, articles in the process of construction, etc.

The problem of finding time for sewing classes in a rural school can be met in various ways. Each grade should have at least one forty-five minute sewing period each week. Two classes can be handled during the same period, the teacher giving the lesson separately to each class. Thus the two lower grades should meet at the same period each week and the seventh and eighth grades on another day. If necessary, the forty-five minute period can be arranged by letting it run over into the noon hour, by having the girls come earlier in the morning and stay after school on days that sewing is taught, or by meeting the class on Saturday.

The work should be completed within a reasonable time, the teacher designating the day upon which the article is due. The teacher should make her instruction so clear and enforce discipline to such an extent that every child will be busy all of the time. Slow or indifferent workers may be required to remain to work after the class is dismissed, as is done for any other school subject. Since the time devoted to sewing in school is short, outside work is advisable in most cases, the girls being permitted to take the garments home according to the discretion of the teacher. Difficulties met with are carelessness of work done at home, forgetting to bring sewing back to school, and in some cases, the making of the article by another member of the family. With no special sewing equipment, it is necessary to have the long seams sewed at home on the machine. When the work is forgotten, the child may read a topic related to sewing or may do some work for the school, as hemming towels. School credit should be given for

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extra home work. Christmas sewing may be considered a reward for those who have completed the regular class problem.

In the higher grades a simple notebook should be kept with measurements, sketches, samples, etc., as a record and reference. A few simple reference books may be kept on the teacher's desk for the pupils' use in making reports or writing compositions. After the completion of each article time should be given for comparison with regard to workmanship and choice of material and for discussion of such matters as use and care of the article made. The pupils should handle their work with such care that laundering of the new garment is unnecessary.

In grading each pupil, the teacher should, of course, consider the willingness of the worker and her previous training. The article itself should be judged in the following respects:

1. General appearance—cleanliness, pressing, folding.
2. Workmanship—
   - (*a*) Stitches, evenness, strength, size;
   - (*b*) Seams—size, evenness;
   - (*c*) Finishings—width, evenness;
   - (*d*) Neatness—removing bastings, fastening thread, distributing gathers, evenness of right and left sides.
3. Choice of materials and trimmings.

At the end of the year, an exhibit should be planned in cooperation with the cooking classes to encourage the interest of the community in the work.

FIFTH GRADE.

The aim in this grade is to teach the use of equipment, the handling of materials, the simple stitches, seams and processes, to develop desirable personal habits, and to stimulate interest in the home.

LESSON I.

1. A list of equipment to be brought by each pupil.

2. Care of equipment and materials. Put name on each article. Wash hands before beginning to sew. Fold material neatly and keep equipment in order.

3. Use of equipment. Sit well back in the chair with the light coming over the left shoulder. Avoid resting the hands on the table when sewing.

The thimble; the thimble finger. Push the needle through the material with the thimble.

Cutting the thread. Measure length of thread from shoulder to shoulder or from hand to elbow. Avoid biting the thread. Fasten the end in the notch on the spool.

The needle. Select a needle just large enough to accommodate the thread. Put the end coming first from the spool through the eye. Hold the needle steady by resting the hands together when threading it. Hold needle in right hand, making knot with the left. Make a small knot at the end of the thread.

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Holding the scissors. Rest the scissors against the table when cutting.

Find the inch and its fractions on the tape measure.

4. Planning the first article—Kettle holder.

The first project should be a simple one that can be completed in a short time and yet test the ability of the class in the application of several of the fundamental stitches.

Materials—washable, such as gingham. Avoid wool material. Samples of suitable materials should be shown to the class. Material for padding—outing flannel, old stockings. Searching the scrap bag for material of proper weight, color, etc.

Amount of material: 12½" by 6½". Dimensions finished—a square 6" x 6". Shapes desirable for holders.

LESSON II.

Lesson Plan.

Date _____ Grade, Fifth.

Title of lesson: Kettle Holder.

General aim—To teach principles of handling materials, including measuring and cutting. To train pupils in taking responsibility, in accuracy, neatness, and economy.

Specific aim—To cut out the holder.

Materials—Class materials, washable cloth for cover, padding, paper patterns, square 5½" by 5½", individual equipment.

Illustrative materials—black board, cloth from which to cut a pot holder, scissors, pins, tape measure, paper pattern.

Subject matter.	*Method.*
Preparation.	"You have all remembered to bring your equipment and the material for the holder." "Why have we chosen material that can be washed?" "Why did you look for suitable material among the scraps at home instead of purchasing a piece for the purpose?"
Presentation— Aim.	"We must cut out the holders today."
1. Cutting the cover— Dimensions 12½"x6½".	The teacher draws rectangle on the board with dimensions.
Seam allowance generally one-fourth inch.	The teacher demonstrates these processes as she explains and questions.
Pulling material straight; if no selvage, get a straight edge by pulling threads at the cut end until one goes all the way across.	
Measuring an even distance from the straight edge.	
Marking with pins.	"Why do we rest the scissors on the table when cutting?"
Cutting in a straight line.	"Is it easier to cut a straight line on plain or striped material?"
Follow a stripe, a thread, or a row of pins.	

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2. Cutting padding.

Dimensions 5½"x5½".	
Paper pattern.	"How would you decide how large to cut the
Pinning straight.	padding for an oval holder?"
Economizing cloth.	The teacher demonstrates pinning pattern.
Number of layers.	
Generalization and summary.	The teacher tests the pupils' understanding of the lesson and makes general applications.
Importance of cutting all material straight and of pinning patterns straight.	"How do we straighten the edge?" "How can we cut plain material in a straight line?" "What should we remember in pinning a pattern?"
Application of the lesson.	The pupils set to work to cut the holders, working independent of the teacher as much as possible. The teacher should carefully supervise the work.

This outline should be followed in presenting any sewing lesson.

Lesson III.

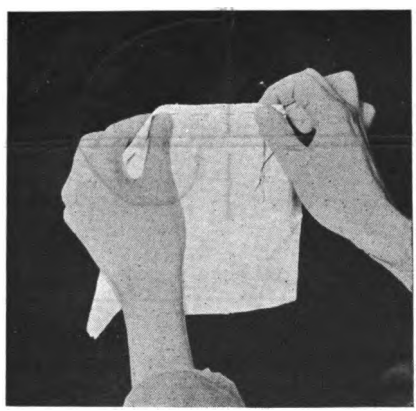
Aim—To turn edges, pin cover and padding together, and to baste.

Review—Cutting straight, use of pattern.

Define terms used in explaining steps in sewing—"Right to left," "Up and down," "Hold material toward you," "Edge," "End," "Parallel."

Turning edges—Have wrong side toward you. Turn top edge down ¼" to wrong side. Use finger nails in creasing, avoiding little plaits in the cloth.

Pinning ready for basting—always pin before basting. Pin edges of holder so they exactly meet, giving special care to the corners.



Position for Basting and Running Stitch.

Even basting. Begin with a knot. Work from right to left with the material toward you. Place the needle in the cloth, then grasp the needle and the material between the thumb and forefinger of the right hand with the thimble against the eye of the needle. Stitches and spaces should be the same size—¼". Fasten with over-and-over stitches, one above the other. Used to hold material temporarily in place until the permanent stitches are made.

Method of teaching any stitch. As she explains the stitch the teacher demonstrates on light colored burlap with dark yarn. A demonstration frame, consisting of a

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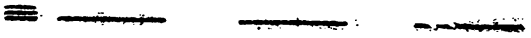
mounted frame stretched with burlap may be used also. The stitch is illustrated by a drawing on the board. For each stitch should be taught the position of the material, position of the needle, direction in which the stitch is made, beginning the thread (avoid knots with most permanent stitches), ending the thread, size of stitches, and the use. Emphasis in the lower grades should be placed upon the evenness of the stitches and upon sewing in a straight line, rather than upon the size of the stitch. After the lesson the children are given scraps of longcloth and colored thread



Basting.

with which to practice the stitch before applying it to the article being made. The teacher carefully inspects the work, demonstrating individually on her own piece of longcloth, never using the pupils' piece. Each stitch should be taught, just before it is to be used on the article.

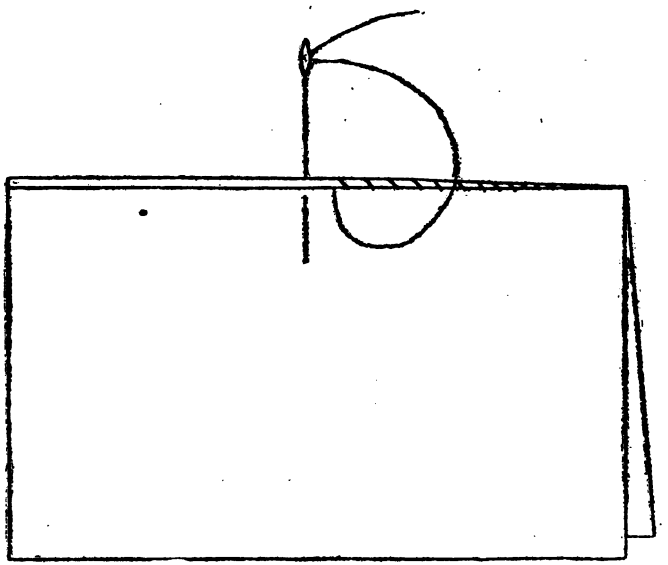
When a seam is taught it should be demonstrated carefully and the size of the seam should be given definitely. Processes should be demonstrated and the more difficult ones such as plackets should be made by each pupil in a practice piece.

Lesson IV.

Aim—To learn overhanding or overseaming.

Review—Basting—size of stitches, use, method.

Overhanding—Let the first few stitches hold down the end of the thread. Work from right to left (as in almost all of the fundamental stitches). Point the needle straight toward you, taking a small amount of each edge in the needle. The following points should be emphasized—uniformity in the distance between the stitches,



Overhanding.

having the stitches slant, taking up a small amount of the edge, and avoiding drawing the thread too tight.

After practicing on their practice pieces, the children should apply the stitch to the holders, finishing at home if necessary.

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Lesson V.

Aim—To review and discuss holders.

Review points of weakness.

The class should examine the finished holders, comparing them for accurate dimensions, even edges, straight cutting, evenness and size of stitches. Advantage of the oval holder. Reasons for using a holder rather than a towel or one's apron. What is the best thing to do if one's clothes catch fire? How often should a holder be laundered? Why should scraps be saved? How can scraps be kept neatly classified?

The points in teaching the holder have been given in detail for guidance in teaching any other article.

Articles to Be Made in the Fifth Grade.

I. KETTLE HOLDER.
II. CLOTHESPIN APRON.

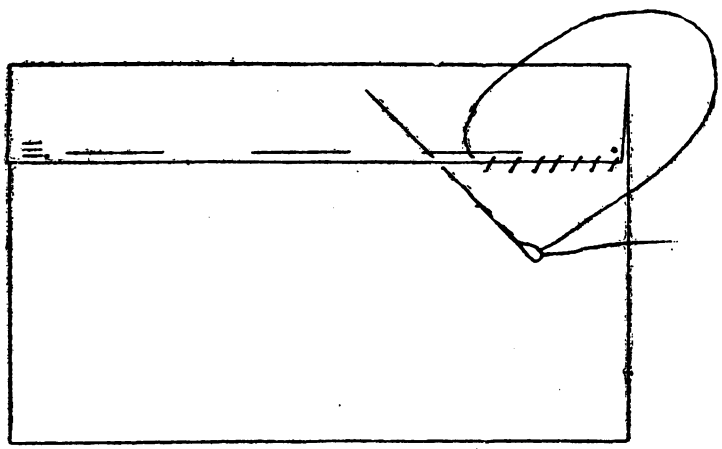
Materials: A piece of appropriate material brought from home, or ½ to ⅔ yard of chambray, $.10; one yard of cotton tape.

STEPS IN MAKING—

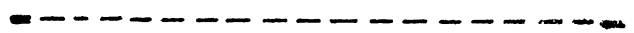
Planning. Discussion of suitable materials, dimensions.

Cutting.

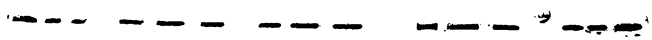
Making. Hems—rules for creasing, rules for size of first turn, basting hems, hemming, plaiting box plaits in pocket piece; plain seam, basting a short distance



Hemming.



Running Stitch.



Combination Stitch.

away from line of permanent stitching, running stitch, back stitch, combination stitch, using the latter for the seam; dividing pocket piece with running stitch; drawing tape through hem at the top.

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Thought developed—importance of strong stitches, saving steps in housework, keeping clothespins clean, having a place for everything.

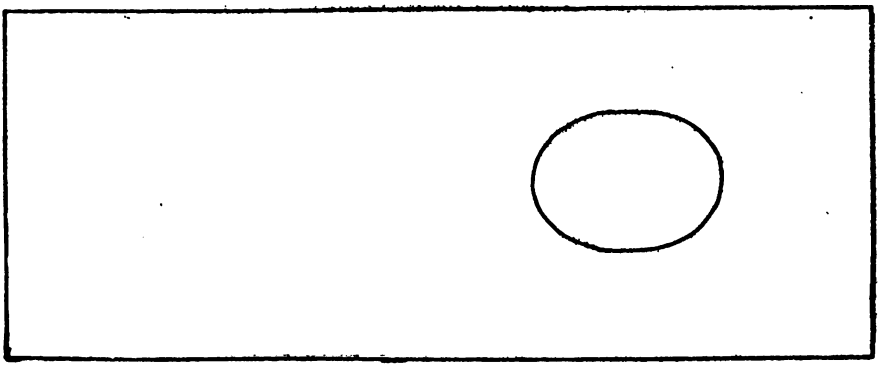
III. FUDGE APRON (to slip over the head with a belt fastening in the front).

Materials: 1½ to 1¾ yard crash toweling at $.20; colored embroidery cotton to match stripe in the toweling, snap fastener.

STEPS IN MAKING—

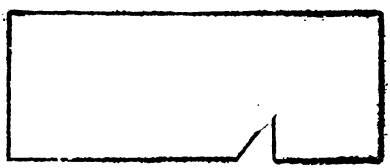
Planning—suitable materials, depth of neck, length in front.

Measuring for amount of material. Take distance from waist line in the back over the shoulder to the bottom of apron, plus width of hem, plus width of two strips for a belt.



Cutting. Straightening the edge of the material, cutting neck opening, cutting belt across the material for the sake of economy.

Making. Hems, creasing and basting narrow hem around a curve, creasing of wide hem with the use of a gauge, basting; simple decorative stitch such as the



Gauge.

chain stitch to hold the edge of hems and to decorate the covered button; process of putting on band; sewing on snap fastener at ends of belt.

Pressing and folding.

Thought developed. Use of various kinds of aprons, economy of the apron, reasons for cleanliness, reasons for accurate measurements, folding garments neatly when putting them away.

IV. CHRISTMAS WORK. PAD FOR A DRESSER DRAWER.

Materials: Figured lawn, dimity or silkaline, cotton sheeting, sachet or lavender, embroidery cotton.

STEPS IN MAKING—

Planning. Materials, measuring dresser drawer for size and shape.

Cutting. Straightening edges, seam allowance, cutting padding.

Making. Opening sheeting and placing sachet; turning edges, pinning, basting; catch stitch to hold edges; tying at intervals to hold layers together.

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Thought developed—the pleasure of doing something for others, importance of accurate measurements; necessity of making a stitch even to make it beautiful, folding and wrapping gift in tissue paper, value of paper lining for every drawer and shelf, frequent change of papers, keeping dresser drawers in good order.

V. DUST CLOTH.

Materials: One square yard of cheese cloth, $.10; embroidery cotton.

STEPS IN MAKING—

Review creasing and basting hem; use one of the fancy stitches learned, to hold down the hem.

Thought developed. Difference between the warp and the woof or weft; the selvage; use of selvage in some cases; use of a hemmed dust cloth rather than any ragged piece; frequent washing of dust cloth; reasons for keeping furniture dusted; proper method of dusting.

VI. DUST CAP.

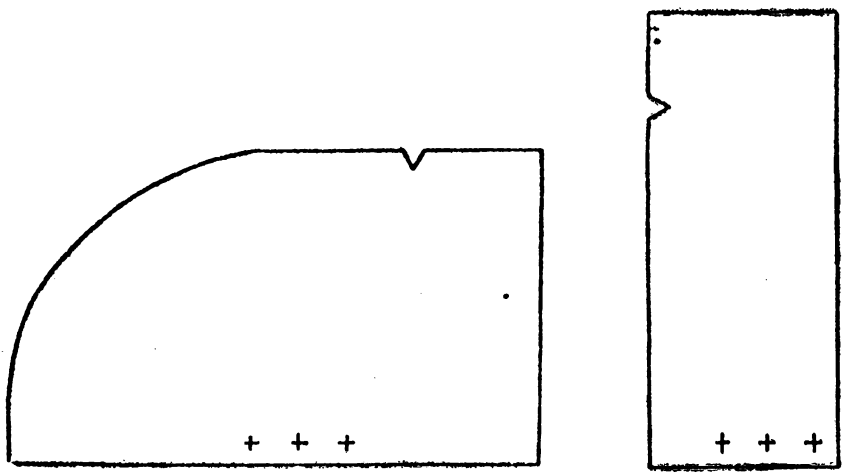
Materials: ½ yard chambray, striped gingham or percale, $.10; ½ yard of tape; embroidery cotton.

STEPS IN MAKING—

Planning. Appropriate materials for a dust cap.

The pattern. Meaning of the marks, laying straight on the cloth. Amount of material. Laying pattern on the table as for the material and measuring the amount needed.

Cutting. Folding material evenly and just wide enough to accommodate the pattern; laying pattern economically, pinning pattern in the straight edge first, cutting



carefully around the edge; marking (never cut) notches, centers, and place for gathers before removing pattern.

Making. Gathering, length of thread, comparing fastening with running stitch, using two separate threads for the two sides of the cap, stroking gathers; French seam—composed of two plain seams (outline on the board the steps for making); assembling the parts, pinning together for French seam with notches and centers meeting, baste with gathers on top, baste from center to end, then from other end to center, running stitch for the first seam, combination stitch for the second seam; hem-creasing, and basting large hem around the entire edge, hem held in place by hemming or by some fancy stitch; making of eyelet; inserting and fastening tape for draw-string.

Pressing and folding.

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Thought developed—economy in purchasing the exact amount of cloth needed and in cutting; importance of trimming seam, creasing carefully and making seam even, reasons for protecting hair when sweeping, care of the hair, washing the cap frequently, proper method of sweeping, kinds of mops, brooms, and other articles used in cleaning.

The fudge apron and the dust cloth may be omitted without destroying the sequence of the projects. The following articles are possible substitutions for those outlined. I. Sewing bag. II. Case for silver, traveling case, laundry bag. III. Case for overshoes. V. Broom case of outing flannel with double ruffle at the bottom, glass or hand towel.

Textiles and Allied Industries.

Since cotton cloth is used for the articles made, cotton and its manufacture should be studied. The teacher can explain the growing, baling and spinning with the use of such illustrative material as the cotton boll, raw cotton, cotton batting, cotton cord, thread of several sizes and pictures illustrating the various processes. The cotton plant can be raised at school. The principles of weaving are related to darning and to weaving done previously in another grade. When a new article is to be made, suitable materials should be handled and discussed with regard to washing, fading, durability, weight, dyeing, name, and price.

The children should be made to appreciate the value of cotton by recalling that cotton is the material most commonly used for all purposes, that it is easily washed, that it is cool in summer, and that colored cotton dresses are very pretty and cheap. They should be urged to avoid getting their clothes very soiled because too frequent washing causes fading.

The best composition from the class in grammar on the growth of cotton should be read to the sewing class. Stories should be told to the pupils about the manufacture of the tools used in sewing, such as needles, pins, scissors, thimbles, buttons, etc.

Sixth Grade.

It is the aim in the sixth grade to develop technic by practice in hand sewing, using finer materials and therefore smaller stitches and by further experience in the use of patterns. The underlying purpose of the instruction should be to develop valuable habits, and to awaken a personal interest in the industrial world and an appreciation of the achievements of modern industry.

Articles to Be Made in the Sixth Grade.

I. PILLOW CASE.

Materials: 1 yard of tubing for each slip at $.20 per yard; white luster cotton at $.05 per spool.

STEPS IN MAKING—

Planning. Width of tubing in relation to size of pillow, width of hem.

Cutting straight.

Making. Joining edges at the end—turning edge, basting with edges meeting, overhanding reviewed, overcasting; hem—turning down the amount allowed for the hem, marking and cutting raw edge in large scallops, turning under scalloped edge, basting, featherstitch.

Thought developed—making a bed; frequent changing of bed linen; airing the bedroom; importance of fresh air in the bedroom, saving the labor of ironing sheets by hanging straight on the line and by folding carefully.

Credit should be given for home work to those bringing the second slip finished.

II. TEA APRON OR SEWING APRON.

Materials: ¾ yard of lawn, dimity or flaxon, $.20; crochet cotton, No. 40.

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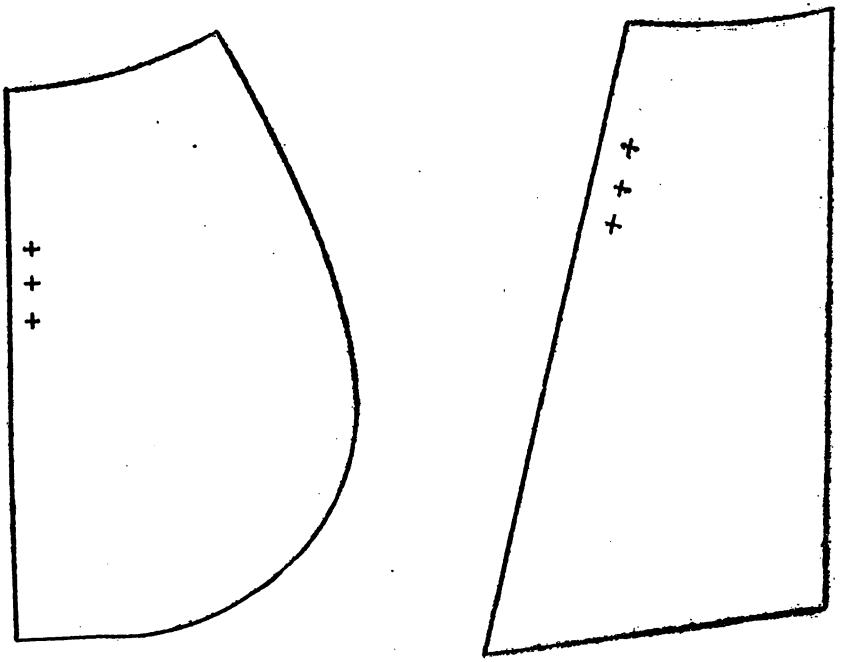
STEPS IN MAKING—

Planning. Appropriate materials and trimming, size and shape.

The Pattern. Study of other patterns; freehand cutting from paper of one-half of pattern; curve for waist line; straight line down the center front; originality in choice of shape; length of belt (waist measure, plus turns, plus lap).



Amount of Material. Laying pattern on the table as it should be laid on the material and taking lengthwise measurement to determine amount needed.

Cutting. Rules for economical cutting; reason for cutting belt along the warp threads; marking centers.

Making. The simplest tatting started in class and finished at home; hem-creasing, basting, blind hemming; overhanding the tatting; dividing in halves and quarters and pinning to the corresponding points on the apron; holding tatting full at the corners; sewing with the tatting on top; belt centers together, baste right half before basting the left half, having seams to the wrong side; combination stitch reviewed; creasing, pinning and basting second edge; overhanding ends and hemming edge. A pocket decorated with tatting may be applied.

Pressing and Folding.

Thought developed—appreciation of reasons for lines and curves in patterns; training the eye; importance of accurate measurements for belts, etc.; reason for difference in strength of warp and weft threads, choosing finer needle and thread for fine work, keeping sewing clean and neatly folded. An afternoon party may be given to the mothers in cooperation with the cooking class, the sixth grade girls wearing their aprons and serving the chocolate and wafers. Such an entertainment gives opportunity for social training.

III. CHRISTMAS WORK.

Only those who have finished the regular work should be allowed to make some article of fancywork.

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Laundry bag of tubing or Indian Head, faced with blue chambray and decorated with an initial in outline or cross-stitch.

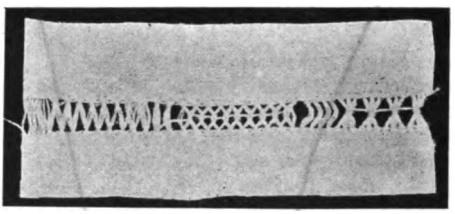
IV. GUEST TOWEL.

Materials: Linen crash, ¾ yard, $.25.

STEPS IN MAKING—

Planning. Length in relation to the width; width of hem in proportion to length; width of trimming in proportion to the width of hem.

Cutting. Cutting edges even by following a thread.



Three simple stitches for hemstitched towels.

Making. Hem—drawing threads where the top of the hem is to come; creasing and basting hem; overhanding reviewed; plain hemstitching; double hemstitching; fancy hemstitching.

Pressing; folding towels.

Thought developed—kinds of toweling and their use; laundering. Why furnish a guest with a separate towel? Why should members of the family have individual towels? Why have paper towels at school instead of roller towels?

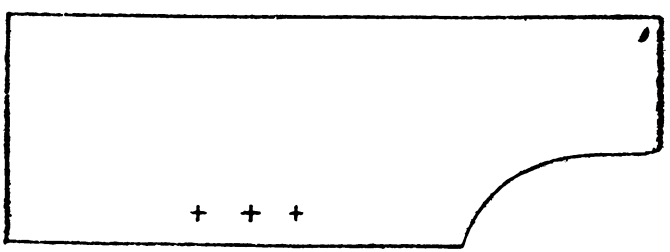
V. CHILD'S EATING BIB.

Materials: ½ yard Indian Head or crash toweling; ½ yard tape; embroidery cotton or crochet cotton.

STEPS IN MAKING—

Cutting from pattern; laying pattern on material economically.

Making. Opportunity should be given for displaying originality and exercising choice in the matter of decoration. Hems—creasing hems, mitering corners. The outline stitch may be used to hold the edge of the wide hems. The edge may be



finished with a narrow hem over which a simple edge is crocheted, or by a narrow hem overcast in both directions to form a cross-stitch along the edge. A design

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appropriate for children may be stamped and worked in outline, cross-stitch, or some other simple decorative stitch.

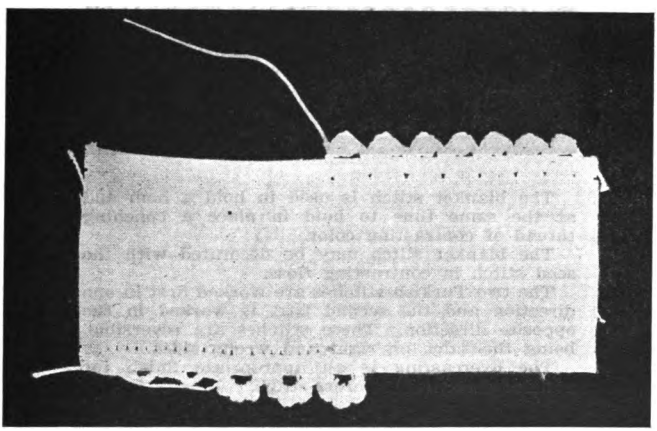
Thought developed—the use of bibs, helping mother take care of the baby.

The following articles may be substituted for those outlined:

I. Book cover, needle book. II. Breakfast cap or combing jacket of the same material. III. Shoe bag, pincushion, napkin ring. IV. Dresser scarf. V. Combing towel or chafing-dish apron of crash toweling.

Textiles and Allied Industries.

The new topic for study is linen with a comparison of its characteristics, growth, and manufacture with that of cotton. The properties of linen and cotton should be compared with respect to their household use. Rapid absorption of moisture and absence of lint, due to the length of fiber make linen the best material for towels and handkerchiefs; the smoothness of surface, gloss, and natural cleanliness are good qualities for table linen; its coolness, especially in the lighter weight fabrics, make it desirable for clothing in summer. Cotton and linen materials appropriate for the



ARMENIAN CROCHET EDGE.

Join thread to linen, chain four, double in second stitch from the hook, treble in the next stitch and double treble into the next. Double into the linen, chain four and repeat.

CROCHET EDGE.

First row.—Make four double crochets into the linen, chain four, skip a space, four double into the linen and repeat.

Second row.—Cover each loop with one double, one treble, two doubles, one treble, two doubles, one treble, one treble. Make two skip stitches between the loops.

articles made in the sewing class should be handled and studied with respect to name, price, use, and method of dyeing. Flax may be grown and studied.

An appreciation of modern textile products should be developed by comparison of old and new methods of manufacture. The study of the development of the textile industry should be treated in such a way as to awaken an interest in the achievements of our great modern industrial system. Pictures of the flax wheel and of the

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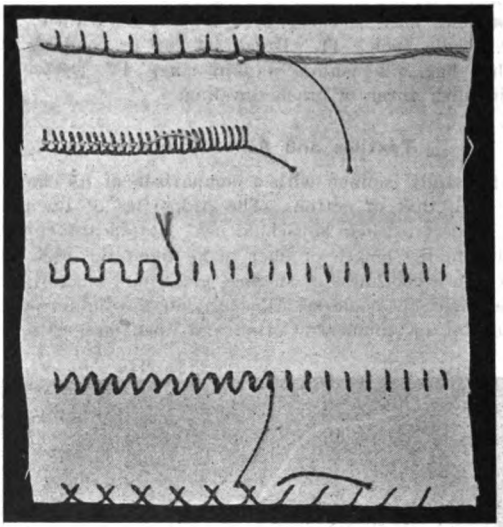
Colonial hand loom and reference to characters familiar to the children in history and literature will serve to make the discussion more interesting.



The blanket stitch is used to hold a hem and at the same time to hold in place a conching thread of contrasting color.

The blanket stitch may be decorated with the seed stitch in contrasting floss.

The two Turkish stitches are worked first in one direction and the second part is worked in the opposite direction. These stitches are reversible, being the same on right and wrong sides.

The overcasting is an appropriate finish for articles decorated in cross-stitch.

Seventh Grade.

Besides practice in hand sewing, the articles selected for the seventh grade should afford opportunity for sewing long seams on the machine. Measuring partners, estimating the amount of material for garments, free-hand cutting of garments, and experience with the commercial pattern should play an important part in the instruction. The care and appreciation of the sewing machine, modern factory and sweat-shop conditions, the care and repair of clothing, and matters of personal hygiene are topics of educational value to be considered in connection with the instruction in sewing.

Articles to Be Made in the Seventh Grade.

I. KIMONA NIGHTGOWN.

Materials. Longcloth at $.20 or cambric at $.18; crochet cotton, No. 50.

STEPS IN MAKING—

Planning. Appropriate materials; trimming; shape of neck.

Amount of Material. Measure from shoulder to floor and multiply by two.

Purchasing. Economy; quick decision.

Measurements. Bust; width across chest from sleeve to sleeve; width of sleeve; depth of neck.

Cutting. Folding material crosswise, then lengthwise, measuring on the material the proper portion of each measurement, marking, cutting to join these points with the proper curves.

Making. Piecing, if necessary; crocheted edge started in class and completed at home; French seam method reviewed; pinning long seams; basting for fitting; bast-

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ing from top to bottom; "fitting," tape sewed in the first seam of the French seam to reinforce the curve; machine stitching; treadling evenly; guiding by gauging edge of material with the edge of the presser foot or some other stationary point; threading parts of the machine; stitching; precautions; finishing neck and sleeves; French hem (similar to damask hem) with the lace overhanded; fitted facing through which ribbon may be drawn or edge crocheted over the basted hem; turning hem—measuring with a ruler an even distance from the floor; turning on the line of pins, cutting an even distance from this crease; small plaits to make the edge fit the skirt; creasing small turn; basting; importance of stitching on the edge.

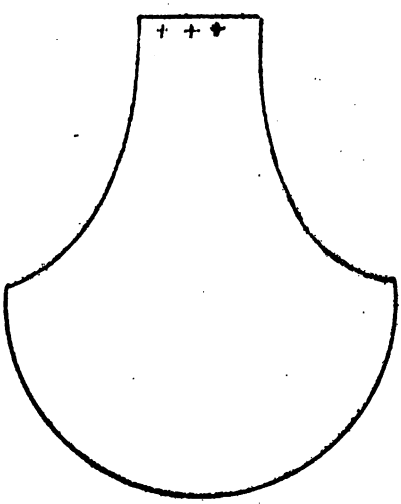
Pressing and Folding.

Thought developed—qualities desirable in material for undergarments; importance of accurate measurements; reasons for each curve in the pattern; reasons for avoiding raw seams in undergarments; history and appreciation of the sewing machine; cooperation with partners in measuring and fitting; talks on personal hygiene; comparison of the ready-made with the garment made at home, in respect to price, quality and durability.

II. Articles for Christmas.

Bags of linen, chintz, or cretonne.

Towel decorated with Swedish weaving. Refer to photographs for bags and for simple designs in Swedish weaving.



III. Knickerbockers.

Materials: Muslin at $.12½ or cambric at $.15. Commercial pattern.

Steps in making—

Planning—materials, design.

Study of the commercial pattern; directions on the envelope; diagram; marks showing how to lay the pattern on the material; those showing how to assemble the parts.

Measurements. Waist; length on hip from waist to knee; altering pattern in length with a tuck.

Amount of Material. Placing pattern on the table as for material and measuring in lengthwise direction.

Cutting. Rules for economical cutting: Fold the material over just the width required by the size of the pattern. Lay all parts of the pattern on the material before beginning to cut. Lay the largest piece on the material first with the large end to the cut end of the material. Cut small parts from small pieces of material. Have approved by the teacher before beginning to cut. Marking notches and centers

Making. The flat fell; review the French seam; plackets—double continuous reinforced at the end by a diagonal line of stitching holding together the two sides of the placket piece; finish the lower edge—hem or gather into a band; bands at the waist; buttonholes; sewing on buttons.

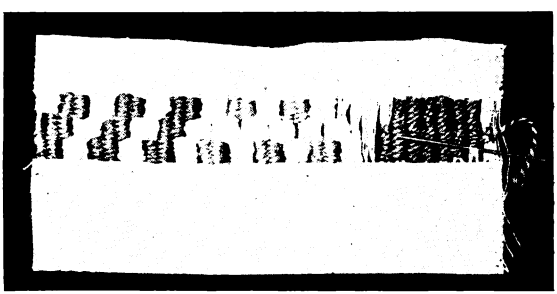
Pressing and folding.

Thought developed. Reasons for economical cutting; matters of hygiene such as frequent bathing; frequent change of clothing on account of the absorption by the clothing of impurities; comparison with ready-made garments.

IV. STOCKING DARNING.

Materials: A stocking with a small hole or a piece of stockinet; darning cotton.

Points considered in darning. Selection of thread to match that in the stocking in color and size; darning on the right side so as to catch the loose loop in the ribs;



Swedish weaving may be done in white, in one color, or in one color and white.

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darning in diamond shape to make the darn flexible; putting the lengthwise threads in first, beginning at one corner of the diamond; leaving a small loop of thread at the end of each line of stitches to allow for stretching, catching the edge of the hole; weaving the crosswise threads in the same way; preserving the diamond shape. The idea of all darning is to replace the worn parts inconspicuously.

Thought developed. Reasons for keeping clothes in repair; washing new stockings before wearing; danger of infection; frequent washing of stockings to prolong their life.

V. HEMMED PATCH.

Materials: Garment to be mended or sampler.

Points considered. Selection of material for patching—matching in color and in strength, therefore preferring old piece to the new. Shape, square or rectangular for all patches except round patches in knit material; large enough to cover all the worn surface. Patches are used where holes are too large to darn.

Steps in making hemmed patch. Pin patch to wrong side of garment, turn in the edges of the patch, baste, hem. Turn to the right side, cut out the worn part, leaving one-half inch; clip corners, turn in edges of garment, baste and hem.

Thought developed. Social value of neatness. Suggestions for the care of clothing, such as brushing wool garments, polishing shoes, hanging clothes on hangers, removing spots of grease, syrup, fruit, and ink. Frequent pressing. Neatness as an indication of character. Value of renovating and remodeling.

The following may be substituted for the articles outlined. I. Bungalow apron decorated with facings; belt and pocket of contrasting cloth. II. Lawn covers for dresses, cases for silver, napkins, etc., collar and cuff set. III. Cooking outfit.

Textile Study.

Since one of the most important reasons for studying textiles is to develop judgment in the purchase of materials, girls of this grade should study the fabrics intensively. In the notebook, on a page entitled "Materials Suitable for Undergarments," should be mounted samples with their name, price, width, and chief characteristic. The pupils should exchange samples and the teacher may supply for study and mounting samples of fabrics used previously in the sewing course. Paste each sample with the greater part loose from the paper so that it may be handled. These samples should be studied as to characteristics, quality in relation to price, durability, and use. Simple tests for quality should be used. Detect the presence of undue size or filling by holding the fabric to the light, by scratching with the finger and by the harshness of feel. Test the closeness of weave by drawing the thumb nail over the surface to see if the threads are easily moved. Test for calendering by rubbing to remove the superficial gloss.

The growth and manufacture of wool should be studied in comparison with cotton, the other short textile fiber. The value of wool for clothing and bedding is appreciated from a consideration of its warmth, lightness, durability and dyeing qualities. A few representative wool materials should be used in illustration.

Eighth Grade.

Experience in the use and alteration of commercial patterns, in measuring, fitting, and other processes of garment making is important for this grade. Since seventy-five per cent of all the children of the United States never reach the high school, the sewing teacher should make the most of her opportunity to develop thoughtfulness in the selection of clothing and household articles with regard to economy, durability, and appropriateness.

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Articles to Be Made in the Eighth Grade.

I. GERTRUDE PETTICOAT OR SLIP.

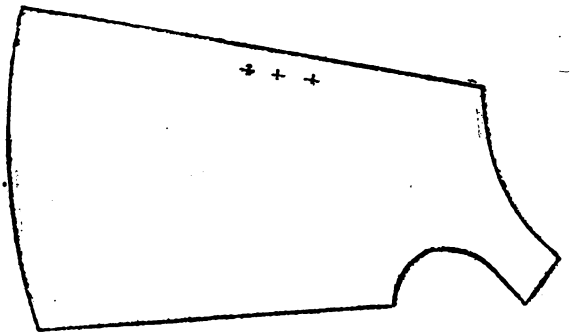
Materials: Longcloth at $.20 or cambric at $.18. Gertrude petticoat—McCall pattern No. 5740. Age 12.

STEPS IN MAKING—

Planning. Qualities desirable in material for an underskirt; kinds of trimming.

Study of the pattern. Marks, directions, shape.

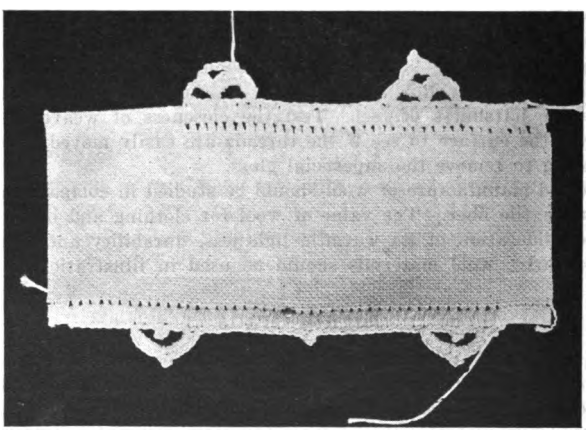
Measurements. Cutting length (finished length from shoulder to lower edge, plus hems, plus seams, plus shrinkage allowance); bust measure. Altering pattern



in length by a tuck in center of the pattern or in the material. Altering in width at the underarm seams.

Cutting. Marking centers, notches, and joining of shoulder strap.

Making. Crocheted edge finished at home; basting on line marked for seam allowance; fitting: rules for fitting any garment—put the garment on with the right side outside. Pin as it is to be fastened when finished. Fit loosely. Remove



wrinkles. Have fitting approved by the teacher. French seam—stitching the width of the French seam away from the line of basting; trimming edge; stitching the second part of the French seam on the basting line; top finish—bias facing or French seam or crocheted lace; lace crocheted over hem or embroidery edge

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attached with a flat fell; buttonholes—placing according to the direction of the strain exerted on the garment; choice of buttons as to size and color.

Pressing and folding.

Thought developed. Size of seams determined by the kind of garment and the weight of material; importance of making the right and left sides of garments exactly alike; economy of making the trimming if time is available; importance of making underskirt at least an inch shorter than the dress; reasons for being neat; value of patience and accuracy. Cost, quality and durability of this garment compared with a similar ready-made garment. An itemized cost of materials should be kept in the notebook with other data such as measurements, rules for estimating the amount of material, and a diagram showing how to lay the pattern economically upon the material.

II. WASH DRESS.

Materials: A cheap, durable wash material, such as gingham. Commercial pattern. Snap fasteners; hooks and eyes. The entire cost of materials should not exceed one dollar.

STEPS IN MAKING—

Designing and planning; appropriate materials for wash dresses; study of fashion sheets; cheap way of trimming effectively, such as the use of contrasting material; making sketch of dress with some original touch in collar, belt, pocket, etc.

Study of Pattern. Two or three patterns typical of the styles may be used as foundation patterns for the dresses made. Altering the style of patterns to give individuality. Measurements by which patterns for various garments are bought. Laying aside parts of pattern not to be used.

Measurements. Bust, waist, hip, length of center front. Altering the pattern.

Amount of material. Laying pattern on table to measure amount required.

Purchasing. Tests for materials; choice of appropriate colors and design, avoiding plaids because of difficulty in matching design at the seams.

Cutting. New problem if material has a right and wrong side; cutting necessary parts double.

Making. Basting for fitting; fitting—Make with as few fittings as possible; kinds of seams for wash dresses; dress placket; basting; fitting and sewing in sleeves; making and attaching collars and cuffs; assembling waist and skirt; hanging skirt after waist line has been finished; sewing on hooks and eyes at waist line; snap fasteners.

Pressing and folding.

Thought developed. Economy in planning and cutting garments; originality in adapting styles to individual needs; selection of patterns appropriate for the wearer; the material, and the use; discussions on clothing expenditure; emphasizing economy; number of garments; care; remodeling and renovating. In application of the above discussion a summer wardrobe may be planned by careful selection of illustrations from fashion sheets with samples of appropriate materials.

The following articles may be substituted for those outlined.

I. UNDERWAIST AND UNDERSKIRT, the latter of gingham, if desired.

An article of fancywork can be used as a problem for those completing the regular sewing on time or for hand work while waiting to use the machine.

Textile Study.

The study of fabrics commonly used is continued in this grade. Dress materials should be mounted with their name, price, width, and chief characteristics. Tests that can be used in the shop or in the home should be applied.

Notice the difference in printed fabrics and dyed fabrics as to fastness of color; the difference between the fabric dyed in the piece and that dyed in the yarn. Test

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for fading by washing a sample; by covering a portion of the sample and exposing it to the sun for a week. Discover the difference between wool fabrics and cotton fabrics by feeling them; by burning the yarn; by untwisting the yarns to detect the appearance of the individual fibers. Determine the wearing quality of wool materials by running a tuck with a needle and pulling to see if strain would cause the garment to pull at the seams. Stretch the material over the thumbs to determine whether the garment would lose its shape when worn.

Silk culture and its manufacture make an interesting study, especially if a few silk worms are raised at school. An appreciation of silk fabrics should be a result of this study. The appropriate use of silk should be considered especially with regard to its use for young girls.

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EQUIPMENT.

Cooking and Sewing.

The establishment of a Home Economics course of study in a rural school is a difficult problem on account of not having available room and the money necessary to purchase the equipment and materials.

It is possible for an energetic teacher to obtain funds by giving school plays, musicals, box socials, lawn parties, and sometimes a bazaar, by selling the simple articles made in the sewing classes.

Interest in the work may be created by contests of home work, organization of canning clubs, and mothers' clubs.

Ten dollars will purchase equipment sufficient to teach the fundamental principles of cooking and sewing.

If the school board is interested in the work, a desirable equipment can be purchased for fifty dollars.

This equipment is meager but sufficient for a class of eight pupils in cooking and sewing.

The same course of study given in the outline can be followed in individual class work, but by the addition of an oven, baking lessons can be included.

Cut 2 illustrates the simplest form of equipment possible for the teaching of cooking in any school.

The work will necessarily be taught by the teacher or some member of the class. After the demonstration has been given, samples of the food can be passed, and the discussion follow.

A simple alcohol stove can be substituted for the oil stove. The work can be carried on by cooking the food on top of the regular heater. A homemade fireless cooker will greatly aid in teaching cooking, as many of the foods started on the oil stove could be finished in the fireless cooker.

The food materials can be purchased by the board, by contributions from each family, one family contributing potatoes, another milk, etc.; by each child paying a small fee; by utilizing the material raised in the school garden.

The sewing equipment can be very simple: most of the work can be taught on the desks, or boards can be put across the desks, or a convenient cutting table can be made under a blackboard, and when not in use, let down, thus not occupying needed space. This same table can be used for cooking demonstrations or table service.

If the work is taught in a regular cooking room, the cooking tables can be used; simple pine tables can be constructed, or boards put across wooden horses.

If no equipment is available, the pupils can keep their work in small pasteboard boxes. East child can bring the necessary articles, such as scissors; the yard sticks and tape lines can be obtained as advertisements.

Cut 6 represents a sewing room that meets many ideal requirements.

Cut 7, a cooking room; oil stoves could be substituted for gas. A working drawing of each will be sent to any address upon application to the Fresno State Normal School.

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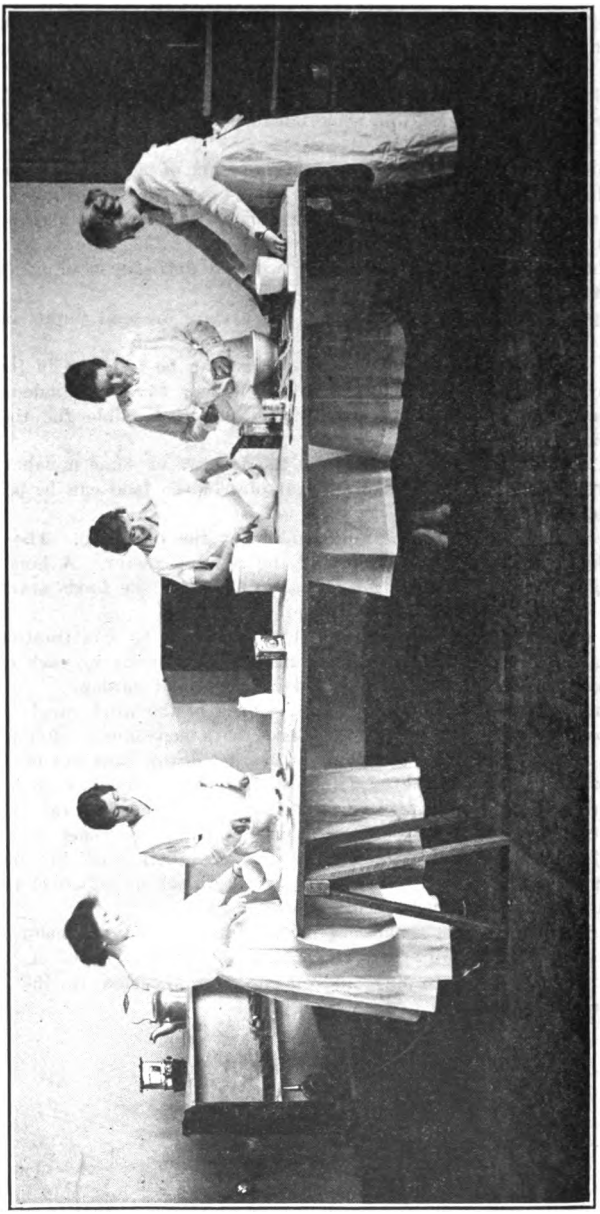

Cut 2.

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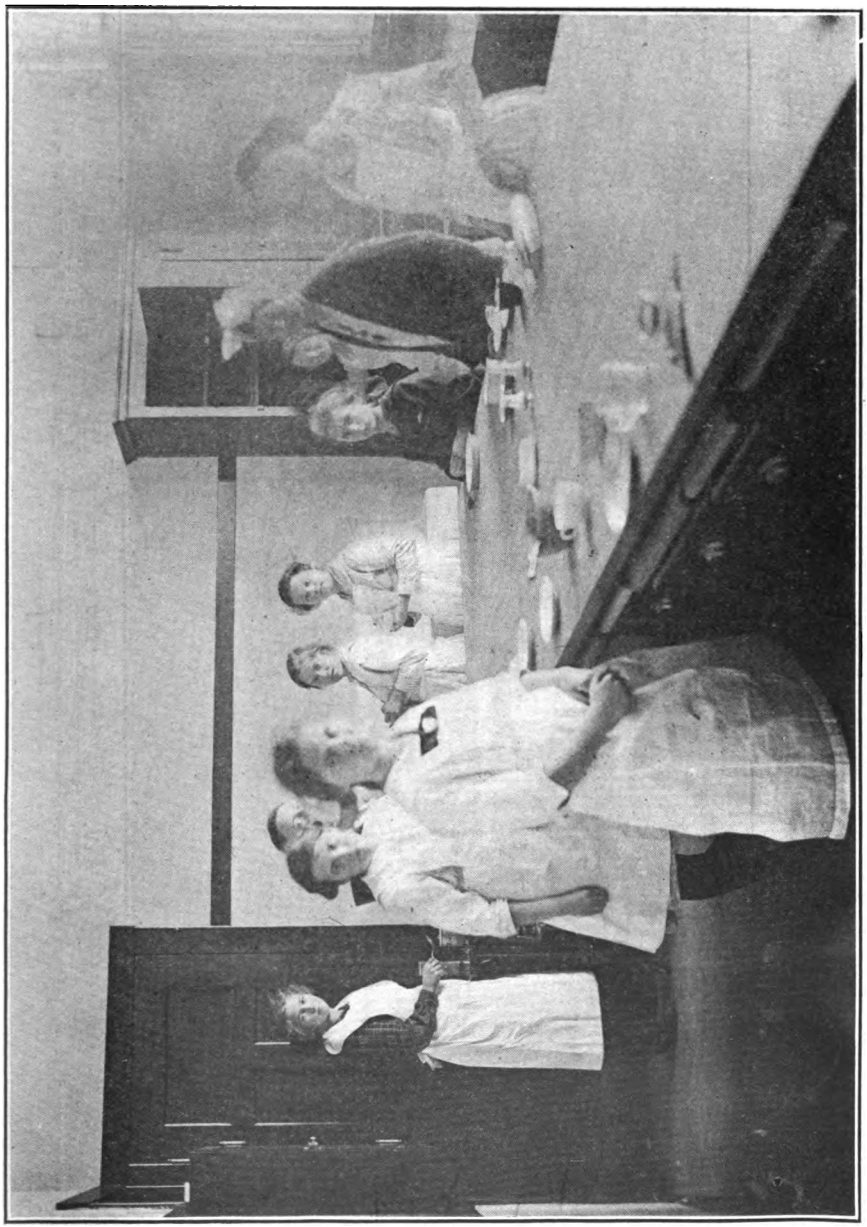

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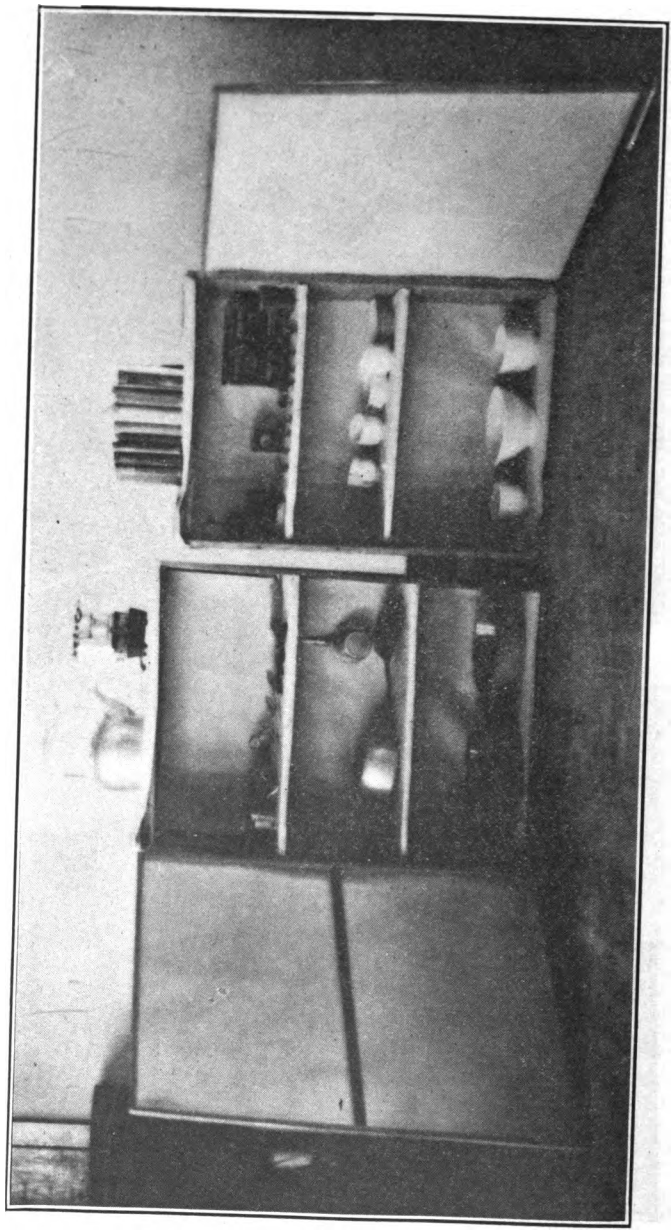

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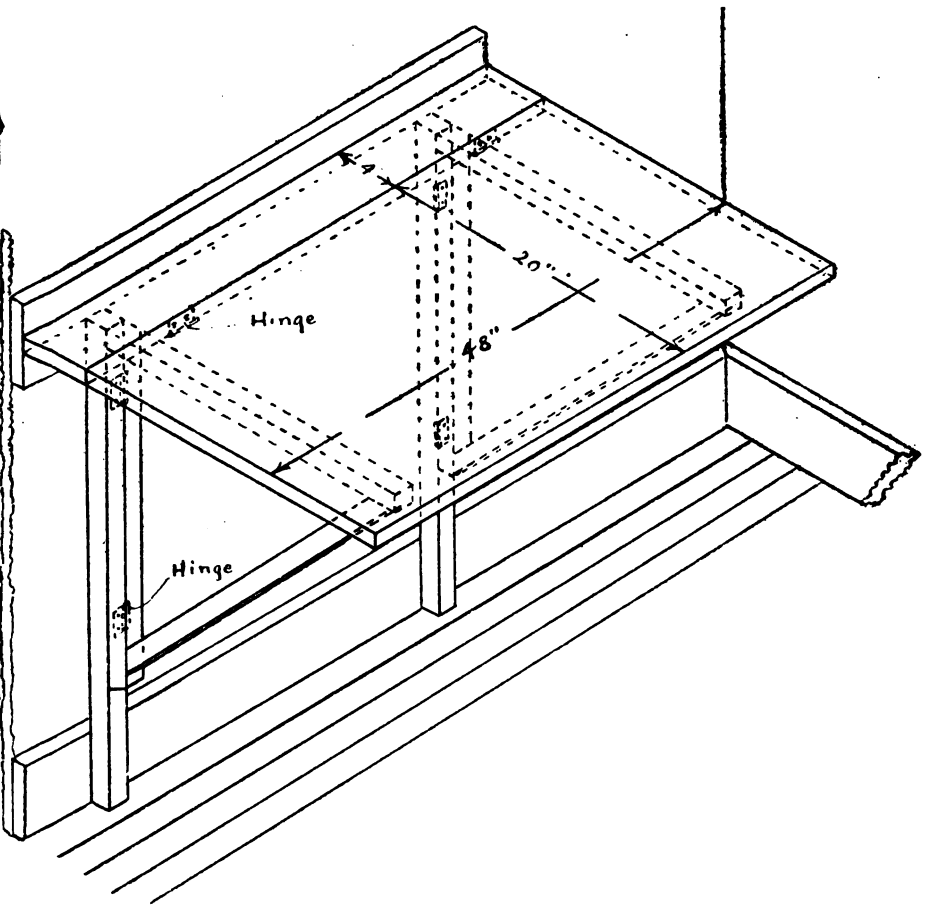

FOLDING WALL TABLE

Top and brackets on hinges

Cut 5

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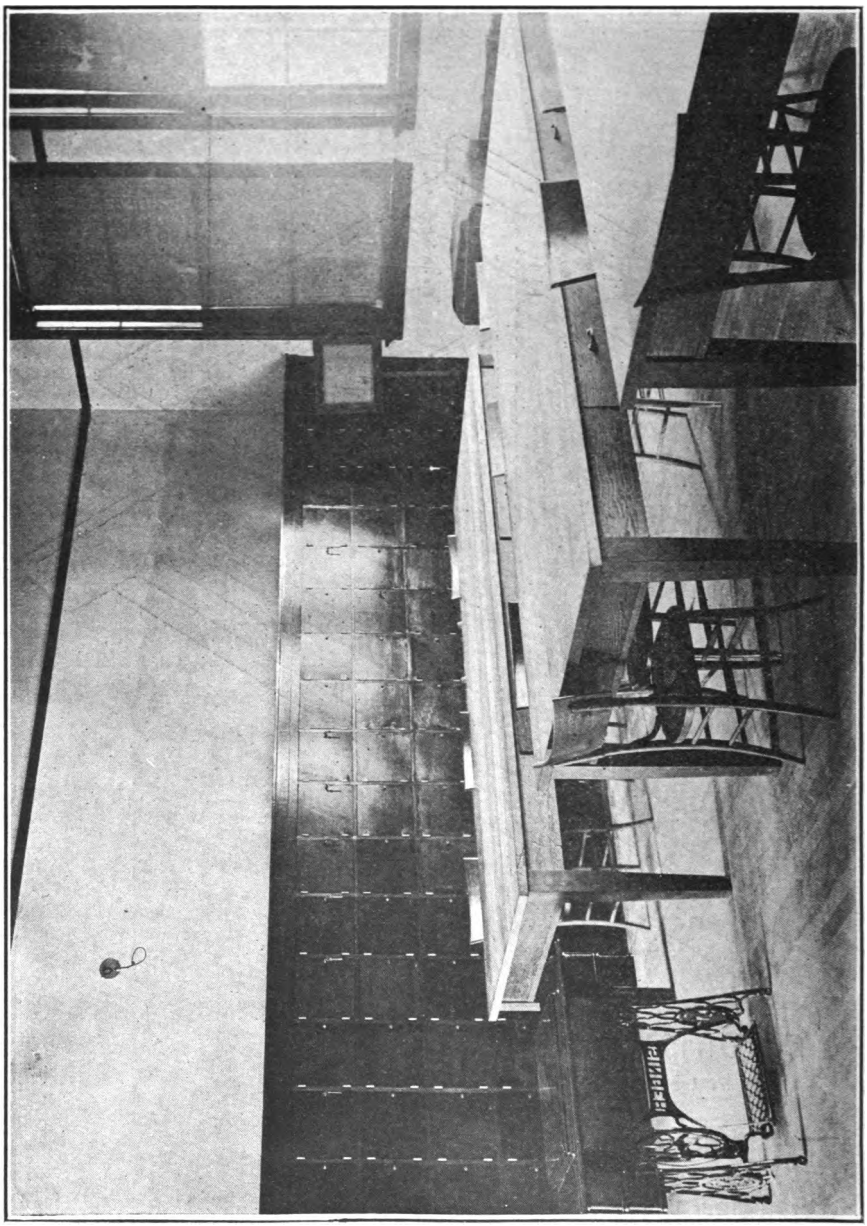

Cut 6.

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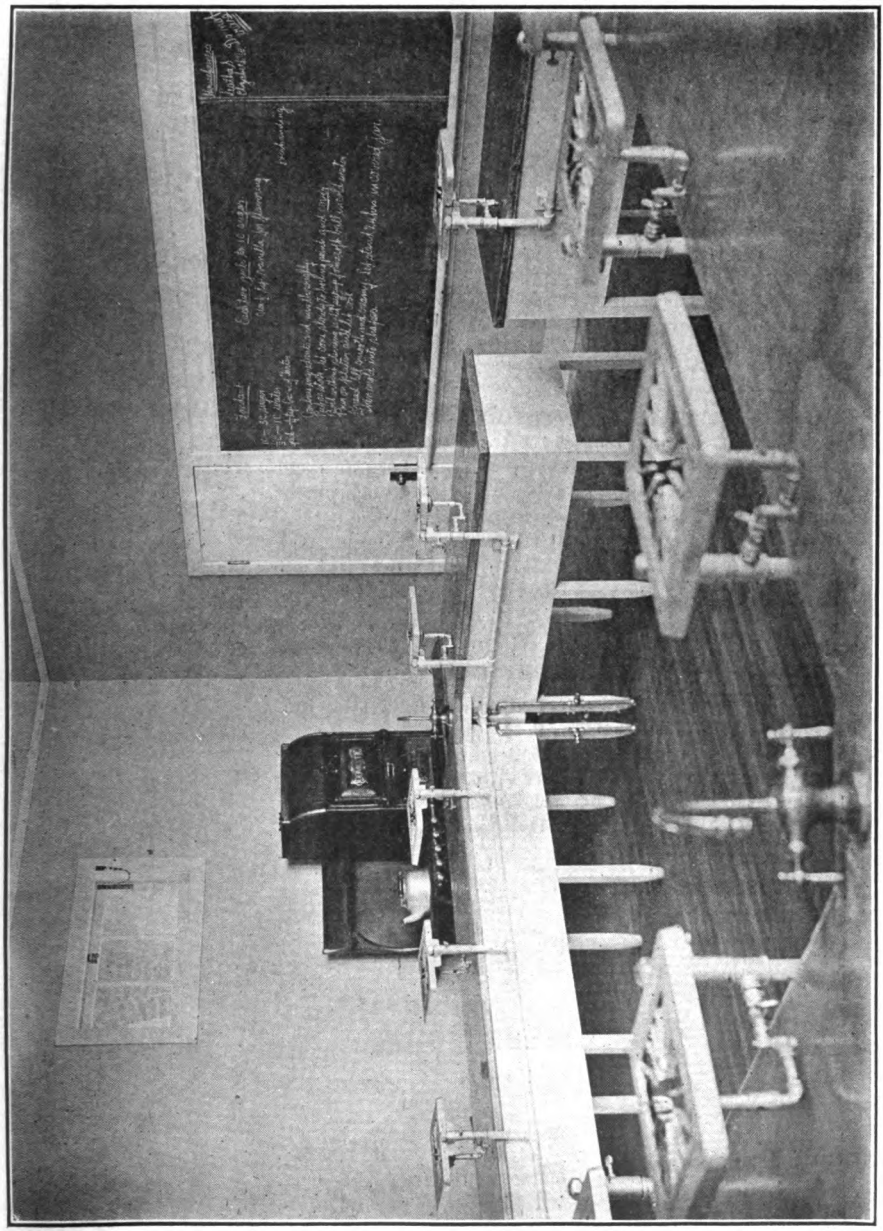

Cut 7.

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Reference Books.

For the pupil:

Kinne and Cooley—"Shelter and Clothing"—Macmillan.
Carpenter—"How the World Is Clothed"—American Book Co.
Gibbs—"Household Textiles"—Whitcomb and Barrows.

For the teacher:

Processes in sewing—

Butterick Publishing Co.—"The Dressmaker."
Woolman—"A Sewing Course"—Fernald.
Baldt—"Clothing for Women"—Lippincott.
Kinne and Cooley.

Textiles:

Woolman and McGowan—"Textiles"—Macmillan.
Kinne and Cooley.

Art Needlework:

Modern Priscilla.
Day, Lewis F.—"Art in Needlework"—Scribners.

Principles of Teaching Domestic Art or Sewing:

Cooley—Domestic Art in Woman's Education—Scribners.
Hygiene, Care of Clothing, Selection of Clothing, etc.
Kinne and Cooley—"Textiles and Clothing."
Woolman and McGowan—"Textiles."

Sewing Bulletins.

Hints on Clothing—Teachers College, New York City, N. Y. 10 cents.

Sewing:

Hints for Choosing Textiles—Cornell Reading Course.
Elementary Sewing—Purdue University, Lafayette, Ind.
Household Furnishing—Cornell Reading Course.
Household Decoration—Cornell Reading Course.
New Methods of Cotton Culture—United States Bulletin 601.
Sewing—Ohio State University, Columbus, Ohio.
Sea Island Cotton—Farmers Bulletin 302.

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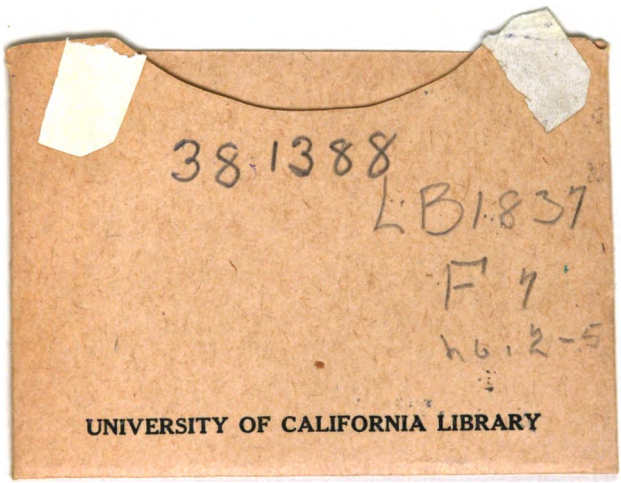

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